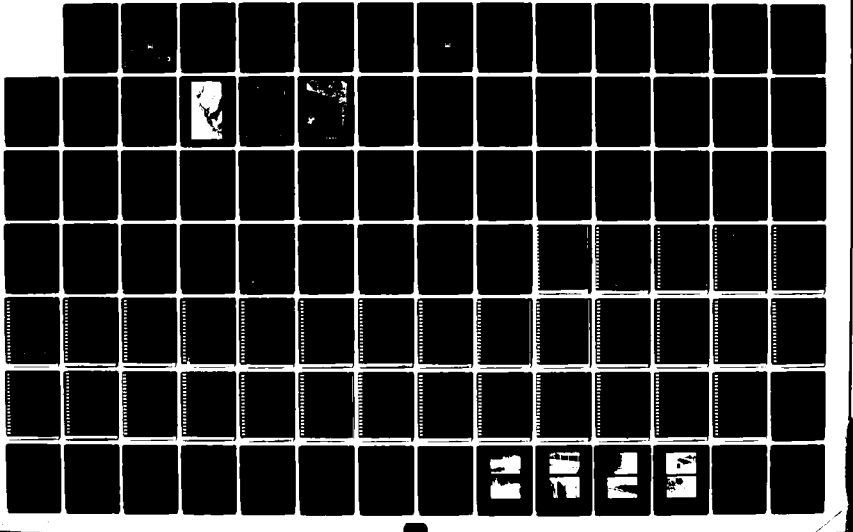
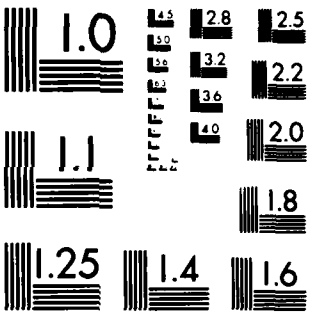
AD-A144 591 NATIONAL PROGRAM FOR INSPECTION OF NON-FEDERAL DAMS 1/2
HANOVER POND DAM (CT..(U) CORPS OF ENGINEERS WALTHAM MA
NEW ENGLAND DIV FEB 79

UNCLASSIFIED F/G 13/2 NL





QUINNIPIAC RIVER BASIN
MERIDEN CONNECTICUT

HANOVER POND DAM
CT 00134

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASS. 02154

FEBRUARY 1979

DISCLAIMER NOTICE

THIS DOCUMENT IS BEST QUALITY PRACTICABLE. THE COPY FURNISHED TO DTIC CONTAINED A SIGNIFICANT NUMBER OF PAGES WHICH DO NOT REPRODUCE LEGIBLY.

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER CT 00134	2. GOVT ACCESSION NO. AD A144 507	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) Hanover Pond Dam NATIONAL PROGRAM FOR INSPECTION OF NON-FEDERAL DAMS		5. TYPE OF REPORT & PERIOD COVERED INSPECTION REPORT 6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) U.S. ARMY CORPS OF ENGINEERS NEW ENGLAND DIVISION		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
11. CONTROLLING OFFICE NAME AND ADDRESS DEPT. OF THE ARMY, CORPS OF ENGINEERS NEW ENGLAND DIVISION, NEDED 424 TRAPELO ROAD, WALTHAM, MA. 02254		12. REPORT DATE February 1979 13. NUMBER OF PAGES 80
14. MONITORING AGENCY NAME & ADDRESS(if different from Controlling Office)		15. SECURITY CLASS. (of this report) UNCLASSIFIED 15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

APPROVAL FOR PUBLIC RELEASE: DISTRIBUTION UNLIMITED

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

Cover program reads: Phase I Inspection Report, National Dam Inspection Program; however, the official title of the program is: National Program for Inspection of Non-Federal Dams; use cover date for date of report.

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

DAMS, INSPECTION, DAM SAFETY,
Quinnipiac River Basin
Meriden Conn.
Hanover Pond Dam

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

The dam is roughly 430 ft. long consisting of a stone and concrete outlet structure abutment 53 ft. in length, a curved spillway 147 ft. long, and an 80 ft. long auxiliary spillway. The maximum height of the dam is about 27 ft. above the bed of the Quinnipiac River.The dam appears to be in fair condition. There are some areas requiring attention. Based upon the size and hazard classification, The Test Flood will be equivalent to the Probable Maximum Flood.

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
424 TRAPELO ROAD
WALTHAM, MASSACHUSETTS 02154

REPLY TO
ATTENTION OF:
NEDED-E

JUN 25 1979

Honorable Ella T. Grasso
Governor of the State of Connecticut
State Capitol
Hartford, Connecticut 06115

Dear Governor Grasso:

I am forwarding for your use a copy of the Hanover Pond Dam Phase I Inspection Report, which was prepared under the National Program for Inspection of Non-Federal Dams. The report is based upon a visual inspection, a review of past performance, and a preliminary hydrological analysis. A brief assessment which emphasizes the inadequacy of the project spillway under test flood conditions is included at the beginning of the report.

The preliminary hydrologic analysis has indicated that the spillway capacity for the Hanover Pond Dam would likely be exceeded by floods greater than 6 percent of the Probable Maximum Flood (PMF), the test flood for spillway adequacy. Screening criteria for initial review of spillway adequacy specifies that this class of dam, having insufficient spillway capacity to discharge fifty (50) percent of the PMF, should be adjudged as having a seriously inadequate spillway and the dam assessed as unsafe, non-emergency, until more detailed studies prove otherwise or corrective measures are completed.

The classification of "unsafe" applied to a dam because of a seriously inadequate spillway is not meant to indicate the same degree of emergency as would be associated with "unsafe" classification applied for a structural deficiency. It does mean, however, that based on an initial screening and preliminary computations there appears to be a serious deficiency in spillway capacity. This could render the dam unsafe in the event of a severe storm which would likely cause overtopping and possible failure of the dam, significantly increasing the hazard potential for loss of life downstream from the dam.

NEDED-E
Honorable Ella T. Grasso

It is recommended that within twelve months from the date of this report the owner of the dam engage the services of a professional or consulting engineer to determine by more sophisticated methods and procedures the magnitude of the spillway deficiency. Based on this determination, appropriate remedial mitigating measures should be designed and completed within 24 months of this date of notification. In the interim a detailed emergency operation plan and warning system should be promptly developed. During periods of unusually heavy preciptiation, round-the-clock surveillance should be provided.

I have approved the report and support the findings and recommendations described in Section 7, with qualifications as noted above. I request that you keep me informed of the actions taken to implement these recommendations since this follow-up is an important part of the non-Federal Dam Inspection Program.

A copy of this report has been forwarded to the Department of Environmental Protection, the cooperating agency for the State of Connecticut. This report has also been furnished to the owner of the project, Mr. Bruce Marks, Director of Public Works, City of Meriden, Meriden Town Hall, Meriden, Connecticut 06450.

Copies of this report will be made available to the public, upon request to this office, under the Freedom of Information Act. In the case of this report the release date will be thirty days from the date of this letter.

I wish to take this opportunity to thank you and the Department of Environmental Protection for your cooperation in carrying out this program.

Sincerely yours,

JOHN P. CHANDLER
Colonel, Corps of Engineers
Division Engineer

QUINNIPIAC RIVER BASIN
MERIDEN CONNECTICUT

HANOVER POND DAM
CT 00134

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASS. 02154

FEBRUARY 1979

BRIEF ASSESSMENT

PHASE I INSPECTION REPORT

NATIONAL PROGRAM OF INSPECTION OF DAMS

Name of Dam:	HANOVER POND DAM
Inventory Number:	CT 00134
State Located:	CONNECTICUT
County Located:	NEW HAVEN
Town Located:	MERIDEN
Stream:	QUINNIPIAC RIVER
Owner:	CITY OF MERIDEN
Date of Inspection:	DECEMBER 7, 1978
Inspection Team:	PETER HEYNEN
	CALVIN GOLDSMITH
	TED STEVENS
	GONZALO CASTRO
	THOMAS KELLER

The dam is roughly 430 feet long consisting of a stone and concrete outlet structure abutment 53 feet in length, a curved spillway 147 feet long, and an 80 foot long auxiliary spillway, the crest of which is 0.4 feet above that of the main spillway. To the right of the auxiliary spillway is an earth dike embankment which is approximately 150 feet in length and has a core wall cutoff consisting of steel sheet piling driven to refusal with a 12 foot wide clayey silt core placed upstream of the sheeting. The maximum height of the dam is about 27 feet above the bed of the Quinnipiac River. The downstream slope of the earth dike is inclined approximately 4 horizontal to 1 vertical. Both the main and auxiliary spillways are broad-crested concrete weirs with a vertical downstream face and inclined reinforced concrete aprons leading to the streambed. The low level sluice gates are 3 feet by 4 feet in dimension and are located in the left abutment structure. All four floor stands to the sluice gates are well maintained and presently operable.

Based on the visual inspection at the site and its past performance, the dam appears to be in fair condition. No evidence of instability was observed in the earth dike, either of the spillways, or in the left abutment outlet structure. There are some areas requiring attention, including the spillway aprons, which are badly deteriorated.

Based upon the size (Intermediate) and the hazard classification (High) of this dam in accordance with Corps of Engineers guidelines, the Test Flood will be equivalent to the Probable Maximum Flood (PMF). Peak inflow to the pond is 74,700 cfs; peak outflow (Test Flood) is 72,900 cfs with the dam overtopped 6.3 feet. Based upon our hydraulics computations, the spillway capacity is 4600 cubic feet per second (cfs), which is equivalent to 6% of the Test Flood.

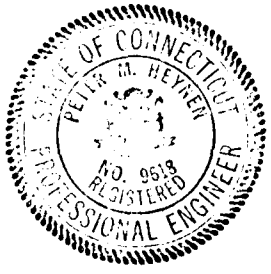
The peak failure outflow from the dam breaching would be 31,700 cfs. An overtopping of the dike of 3.5 feet without breaching would cause flooding of the retail boat store located immediately downstream of the dam with a potential for loss of life. A breach of the dike or a collapse of the spillways would develop a 12 foot wave with an increased potential for loss of life.

It is recommended that further studies be undertaken to perform a more refined hydraulic/hydrologic study to determine the best way to increase the capability of the spillway to pass a greater percentage of the Test Flood.

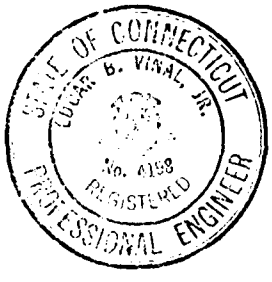
It is further recommended that a registered professional engineer investigate the deteriorated spillway aprons and develop a repair scheme or redesign which will preclude future damage to the spillway or aprons.

An operations and maintenance plan should be instituted, to include complete documentation for future reference. Maintenance presently required includes filling of eroded areas of the dike adjacent to the auxiliary spillway, removing trees on the dike adjacent to the auxiliary spillway, and the placement of rip rap on the upstream slope of the dike for erosion protection.

The above recommendations and remedial measures, as further described in Section 7, should be instituted within one year of the owner's receipt of this Phase I Inspection Report.



Peter M. Heynen, P.E.
Project Manager
Cahn Engineers, Inc.



Edgar B. Vinal, Jr., P.E.
Senior Vice President
Cahn Engineers, Inc.

This Phase I Inspection Report on **Hanover Pond Dam**
has been reviewed by the undersigned Review Board members. In our opinion, the reported findings, conclusions, and recommendations are consistent with the Recommended Guidelines for Safety Inspection of Dams, and with good engineering judgment and practice, and is hereby submitted for approval.

Joseph A. McElroy

JOSEPH A. MCELROY, MEMBER
Foundation & Materials Branch
Engineering Division

Carney M. Terzian

CARNEY M. TERZIAN, MEMBER
Design Branch
Engineering Division

Joseph W. Finegan, Jr.

JOSEPH T. FINEGAN, JR., CHAIRMAN
Chief, Reservoir Control Center
Water Control Branch
Engineering Division

APPROVAL RECOMMENDED:

Jos B. Frimp

JOE B. FRIMP
Chief, Engineering Division

PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I Investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspection. Detailed investigation, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I Investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized at the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam would necessarily represent the condition of the dam at some point in the future. Only through continued care and inspection can there be any chance that unsafe conditions will be detected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the Spillway Test Flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions there of. Because of the magnitude and rarity of such a storm event, a finding that a spillway will not pass the test flood should not be interpreted as neccessarily posing a highly inadequate condition. The test flood provides a measure of relative spillway capacity and serves as an aid in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

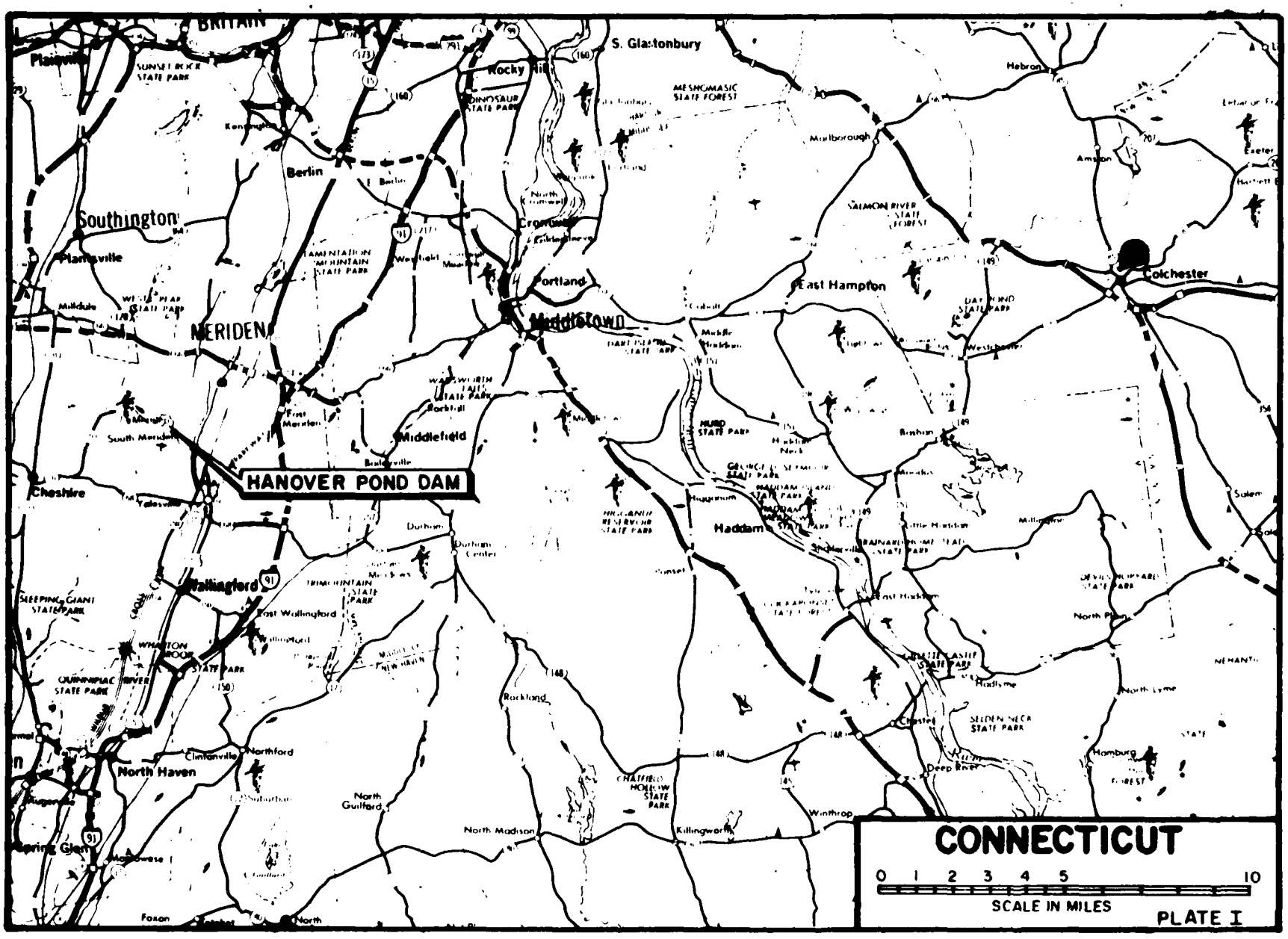
TABLE OF CONTENTS

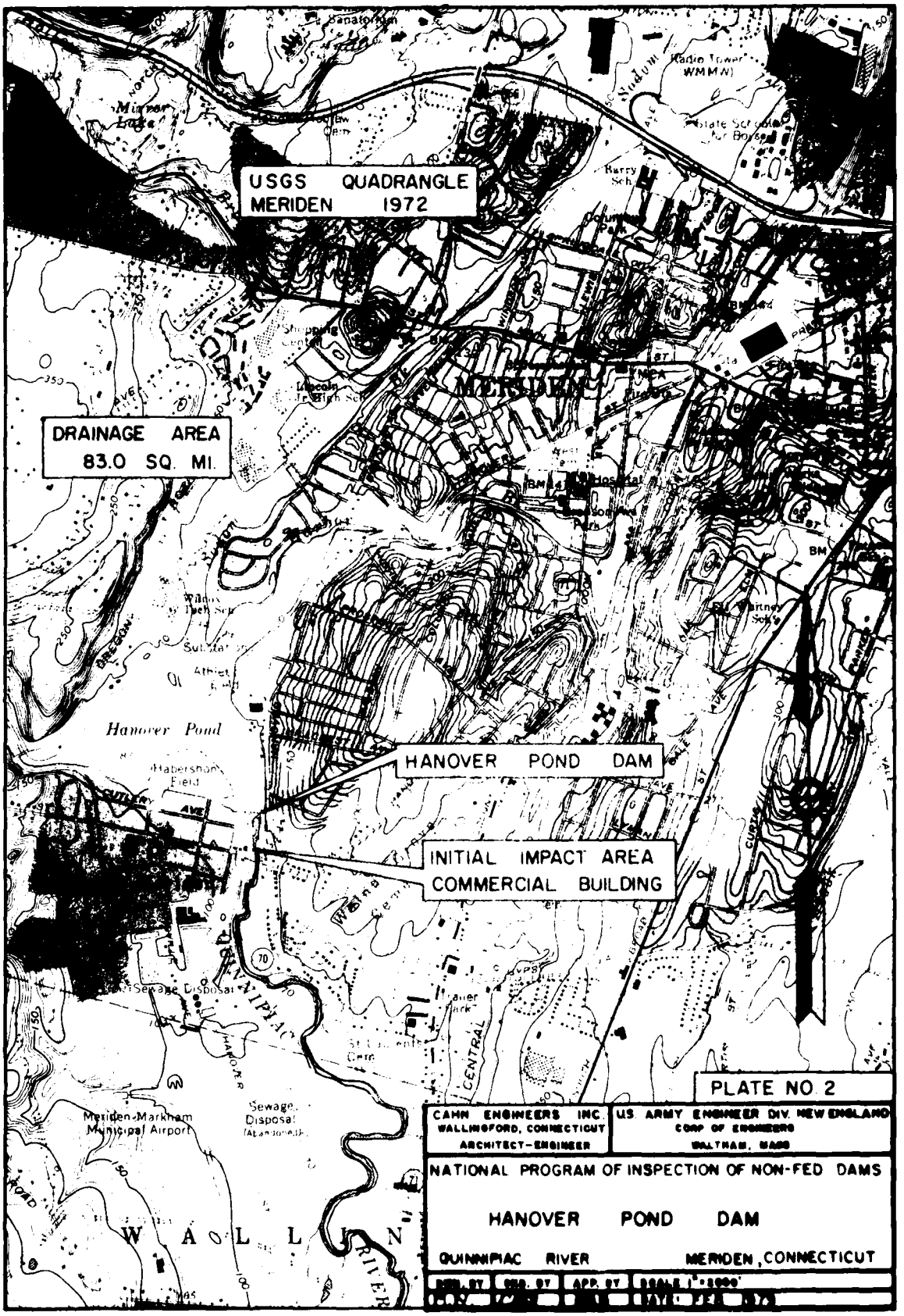
SECTION 7: ASSESSMENT, RECOMMENDATIONS & REMEDIAL MEASURES

APPENDIX

OVERVIEW PHOTO

US ARMY ENGINEER DIV. NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MASS. CAHN ENGINEERS, INC. WAKEFIELD, MASS. ARCHITECT-ENGINEER	NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS	[illegible] DAM	[illegible]	DATE [illegible] [illegible] [illegible]


HANOVER POND DAM
CONNECTICUT
0 1 2 3 4 5 10
SCALE IN MILES
PLATE I
BRITAIN
Plainville
SUNSET RIDGE STATE PARK
Rocky Hill
DINOSAUR STATE PARK
S. Glastonbury
MESHOMASIC STATE FOREST
Hebron
Berlin
Marlborough
Amston
Exeter
Southington
Plantsville
Cromwell
SALMON RIVER STATE FOREST
Portland
Middletown
East Hampton
Colchester
MERIDEN
Middlefield
Cheshire
Durham
Haddam
Wallingford
East Wallingford
SLEEPING GIANT STATE PARK
QUINNIPIAC RIVER STATE PARK
Rockland
North Haven
Clintonville
Northford
North Guilford
North Madison
Killingworth
Winthrop
Deep River
Salem
North Lyme
Hamburg
Spring Glen
Foxon
North


USGS QUADRANGLE
MERIDEN 1972
DRAINAGE AREA
83.0 SQ. MI.
HANOVER POND DAM
INITIAL IMPACT AREA
COMMERCIAL BUILDING
Hanover Pond
MERIDEN
WALLINGFORD
Meriden-Markham Municipal Airport
Sewage Disposal
Habershon Field
Mirror Lake
Radio Tower WMMW
PLATE NO 2
CAHN ENGINEERS INC.
WALLINGFORD, CONNECTICUT
ARCHITECT-ENGINEER
U.S. ARMY ENGINEER DIV. NEW ENGLAND
CORP OF ENGINEERS
WALTHAM, MASS
NATIONAL PROGRAM OF INSPECTION OF NON-FED DAMS
HANOVER POND DAM
QUINNIPIAC RIVER
MERIDEN, CONNECTICUT

PHASE I INSPECTION REPORT

HANOVER POND DAM

SECTION I

PROJECT INFORMATION

1.1 General

a. Authority - Public Law 92-367, August 8, 1972, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a National Program of Dam Inspection throughout the United States. The New England Division of the Corps of Engineers has been assigned the responsibility of supervising the inspection of dams within the New England Region. Cahn Engineers, Inc. has been retained by the New England Division to inspect and report on selected dams in the State of Connecticut. Authorization and notice to proceed were issued to Cahn Engineers, Inc. under a letter of November 28, 1978 from Max B. Scheider, Colonel, Corps of Engineers. Contract No. DACW33-79-C-0014 has been assigned by the Corps of Engineers for this work.

b. Purpose of Inspection Program - The purposes of the program are to:

(1) Perform technical inspection and evaluation of non-federal dams to identify conditions requiring correction in a timely manner by non-federal interests.

(2) Encourage and prepare the States to quickly initiate effective dam inspection programs for non-federal dams.

(3) To update, verify and complete the National Inventory of Dams.

c. Scope of Inspection Program - The scope of this Phase I inspection report includes:

(1) Gathering, reviewing and presenting all available data as can be obtained from the owners, previous owners, the state and other associated parties.

(2) A field inspection of the facility detailing the visual condition of the dam, embankments and appurtenant structures.

(3) Computations concerning the hydraulics and hydrology of the facility and its relationship to the calculated flood through the existing spillway.

(4) An assessment of the condition of the facility and corrective measures required.

It should be noted that this report does not pass judgement on the safety or stability of the dam other than on a visual basis. The inspection is to identify those features on the dam which need corrective action and/or further study.

1.2 Description of Project

a. Description of Dam and Appurtenances - The dam is roughly 430 feet long consisting of a stone and concrete bulkhead abutment 53 feet in length, a curved spillway 147 feet long and an 80 foot long auxiliary spillway, and an earth embankment to the right of the spillways, which is approximately 150 feet in length. The earth dike has a core wall of clayey silt which is thought to be approximately 12 feet wide. The maximum height of the dam is in excess of 25 feet. The dike has downstream slopes on the order of 4 horizontal to 1 vertical. Both the left curved spillway and the right auxiliary spillway are broadcrested concrete weirs with vertical downstream faces and inclined reinforced concrete aprons to the streambed. The left dam abutment appears to be founded on rock while the right, auxiliary spillway and dike were constructed by first driving steel sheet piling to refusal. The low level outlets are 3 foot by 4 foot sluice gates located within the left dam abutment. All four sluice gates are presently operable.

b. Location - The dam is located on the Quinnipiac River in a rural area of the City of Meriden, County of New Haven, State of Connecticut. The dam is shown on the Meriden U.S.G.S. Quadrangle Map having coordinates latitude N 41° 31.2' and longitude W 72° 49.6'. Downstream of the dam there is a retail boat store, a sewage treatment facility and the community of Yalesville.

c. Size Classification - (Intermediate) The dam impounds an estimated 1800 acre-feet of water with the pond level at the top of the dam, which at elevation 94, is approximately 27 feet above the streambed of the Quinnipiac River.

d. Hazard Classification - HIGH - The initial impact area consists of a retail boat store located immediately downstream of the dam. Further downstream are a few isolated structures and a sewage treatment plant. Approximately 2 miles downstream from the dam, the Quinnipiac River flows through the community of Yalesville. During the recent storm of January 25, 1979, there was flooding along the river with the most extensive flooding occuring at a trailer park adjacent to the river in Yalesville. Overtopping of the dike, even without failure, has potential for loss of life at the retail store immediately downstream of the dam.

e. Ownership City of Meriden
Meriden Town Hall
Meriden, Connecticut
Mr. Bruce Marks,
Director of Public Works
(203) 634-0003

f. Operator - None

g. Purpose of Dam - Recreational.

h. Design and Construction History - The dam was originally constructed in 1915. After a portion of the embankment was washed out by the 1938 hurricane, Clarence M. Blair, a member of the Connecticut Board of Supervision of Dams, ordered the City of Meriden to lower the dam 3 feet in order to place the structure in a safe condition. No work was performed until 1950, when the auxilliary spillway was constructed. No final certificate of approval was issued for the auxilliary spillway. On March 14, 1962, the auxiliary spillway collapsed. It was repaired in September 1962, however, the adjacent embankment was still lower than designed.

On April 25, 1968, a 75 foot long breach of the dike at the right end of the dam occurred and drained nearly the entire pond. During the autumn of 1968, repairs to the dike

were carried out including the driving of sheet piling and the reconstruction of the impervious dike core using a "blended clay-soil material". Sluice gates of the type depicted at the end of Appendix Section B were installed in the early 1970's.

i. Normal Operational Procedures - The sluice gates are opened with a gasoline powered wrench approximately 3/4 of the way when the backwater of Hanover Pond causes upstream flooding. Care is taken to limit the flow somewhat due to the concern for the facilities of the sewage treatment plant located downstream adjacent to the Quinnipiac River. It should be noted that the gasoline powered wrench is stored off-site at the City of Meriden Public Works facilities.

1.3 Pertinent Data

a. Drainage Area - 83.0 square miles of rolling to flat coastal terrain. The drainage area is mostly rural, with the majority of the developments being residential. A portion of the drainage area along Sodom Brook includes parts of the City of Meriden.

b. Discharge at Damsite - Discharge from the pond is from the main and auxiliary spillways and from four low level sluice gates.

Outlet works (4 sluices):	3' x 4' at Invert el. 70.2
Maximum known flood at damsite:	N/A
Ungated capacity of spillways at top of dam:	4600 cfs at el. 91
Ungated capacity of spillways at test flood elevation:	4600 cfs
Gated spillway capacity at normal pool elevation:	N/A
Gated spillway capacity at test flood elevation:	N/A
Total spillway capacity at test flood elevation:	46^0 cfs
Total project discharge at test flood elevation:	N/A

c. Elevations - (Ft. above M.S.L., U.S.G.S. Datum)

Streambed at centerline of dam:	67 (approx.)
Maximum tailwater:	N/A
Upstream portal invert diversion tunnel:	N/A
Recreation pool:	
Full flood control pool:	N/A
Spillway crest	
(main - left):	87.5
(auxiliary - right):	87.9
Design surcharge (Original Design):	N/A
Top of Dam (Dike):	94
Test flood design surcharge:	100+

d. Reservoir

Length of maximum pool:	3400+ ft.
Length of recreation pool:	3400 ft.
Length of flood control pool:	N/A

e. Storage

Recreation pool:	N/A
Flood control pool:	N/A
Spillway crest pool:	N/A
Top of dam (el. 94):	1800 ac. ft. (estimated)
Test flood pool:	1800+ ac. ft.

f. Reservoir Surface

Top of dam (el. 94):	76+ acres
Test flood pool (el. 100^{+}_{-}):	76+ acres
Flood-control pool:	N/A
Recreation pool:	76 acres
Spillway crest:	76 acres

g. Dam

Type:	Concrete and stone construction for spillways and left abutment & bulkhead. Earth dike embankment with steel sheet piling and clayey silt core.

Length (total):	430 ft.
Height:	25+ ft.
Top Width (Dike):	45 ft. (variable)
Side Slopes (Dike):	4H to 1V (downstream)
Zoning:	N/A
Impervious Core (Dike):	Clayey silt - 12' wide
Cutoff (Dike & Auxiliary Spillway):	Steel sheet piling driven to refusal
Grout curtain:	N/A
Other:	None

h. Diversion and regulating tunnel - N/A

Type
Length
Closure
Access
Regulating Facilities

i. Spillways

Type:	Broadcrested concrete weirs with vertical downstream faces
Length of weirs:	147 ft. (left - main) 80 ft. (right - auxiliary)
Crest elevations:	87.5 (left) 87.9 (right)
Gates:	N/A
U/S Channel:	Shallow sand and gravel slope
D/S Channel:	Inclined reinforced concrete aprons to streambed
General:	N/A

j. Regulating Outlets (Four sluices)

Invert:	70.2
Size:	3' x 4'
Description:	Sluices with gates
Control Mechanism:	4 floor stand lifts
Other:	Trash racks to sluices

SECTION 2: ENGINEERING DATA

2.1 Design

a. Available Data - The available data consists chiefly of drawings and correspondence by the City of Meriden, the members of the State Board of Supervision of Dams, and the U.S. Army Corps of Engineers.

b. Design Features - The drawings are mostly proposed repair or alteration schemes. It was difficult to discern what actually was used for the construction of the dam and appurtenances. The composite plan in this report is based upon the existing plans as they relate to what was actually seen during our field inspections.

c. Design Data - There were no engineering values, assumptions, test results or calculations available for the original construction. Post 1938 alteration or repair schemes were proposed in detail, although it appears no actual work was undertaken for the auxiliary spillway until 1950. Drawings for this work are proposed, rather than as-built drawings.

2.2 Construction

a. Available Data - Borings and compaction tests by the Hamden Testing Company for the 1968 embankment reconstruction are available from the State of Connecticut Department of Water and Related Resources, a division of the Department of Environmental Protection.

b. Construction Considerations - No information was available.

2.3 Operations

During heavy storms, the police check the dam periodically. Lake level readings are taken only during storms.

2.4 Evaluation

a. Availability - Existing data was provided by the State department of Water and Related Resources, and by the City of Meriden. The owner made the dam available for visual inspection.

b. Adequacy - The limited amount of as-built engineering data available made it impossible to perform an in-depth assessment of the dam. The final assessement of this investigation must be based, therefore, on the visual inspections, performance history, hydraulic computations of spillway capacity, and approximate hydrologic judgement.

c. Validity - Except for the proposed plans and the as-built conditions as discussed in 2.1.b, a comparison of record data and visual observations reveals no observable significant discrepencies in the record data.

SECTION 3: VISUAL INSPECTION

3.1 Findings

a. General - The general condition of the dam is fair. Inspection revealed areas requiring attention.

b. Dam - At the time of our initial inspection the water level in the pond was at elevation 87.9, approximately.

Dike - The earth dike to the right of the auxiliary spillway was in good condition at the time of our inspection. There were no seeps or areas of sloughing evident. There was an area of the upstream part of the dike near the right spillway abutment that has not been filled in and appears to have been used as a ramp for construction and maintenance equipment to gain access to the upstream edge of the dam. This is illustrated in Photo 1. There has been some erosion on the upstream face, the crest, and the downstream face of the dike adjacent to the auxiliary spillway right wingwall. Trespassing was evident on the crest and downstream face of the dike. The downstream face has some minor erosion, but the majority of it is grass covered with no significant signs of erosion. There is a group of trees growing adjacent to the right, auxiliary spillway wingwall on the downstream face of the dike, which are shown in Photo 2.

Main Spillway - The main spillway appears to have a concrete downstream vertical face with an inclined concrete apron immediately downstream, and a horizontal concrete apron downstream of the inclined apron. The horizontal apron has broken into many pieces and separated from the inclined apron; many pieces are missing, especially at its downstream edge as shown in Photo 4. Water flowing over the edge of the horizontal apron probably undermined the apron causing it to crack. The cracked pieces were probably carried downstream during periods of high spillway discharge. Water flowing into the gap between the inclined apron and horizontal apron is probably undermining both aprons (see Photo 5).

Auxiliary Spillway - The downstream face of the auxiliary spillway consists of sheet piling. The upper inclined apron of the auxiliary spillway, downstream of the sheet piles is in good condition. The lower, near

horizontal apron of the auxiliary spillway is in poor condition. It is cracked in many places and reinforcing is exposed in several areas. Concrete pieces of the lower apron are missing. There are trees growing near the edge of the lower apron which may have contributed to cracking of the apron as seen in Photo 6.

c. Appurtenant structures - The low level outlets are sluices through the left dam abutment and are operated by 4 relatively new floor stands. The floor stands are operated by a gasoline powered wrench which is stored off-site at the City of Meriden Public Works facilities. An upstream view of the new floor stands and of a small portion of the trash racks protecting the sluice gates is shown in Photo 3. The abutment itself is of concrete and stone masonry construction and is in good condition.

The upstream approaches to both spillways were observed to be shallow, approximately 1 foot below the crests of the spillways.

d. Reservoir area - The area surrounding the reservoir is partially developed with single family residences, with the remainder of the shoreline being wooded land or fields.

e. Downstream Channel - The channel is a sand and gravel bottom with debris collected near the downstream edge of the main spillway. Numerous trees grow on the bottom of the channel, some of which have caused deterioration of the lower apron of the auxiliary spillway.

Several seeps were observed through the rock ledge exposed on the left side of the channel just downstream of the outlet structure. Water was observed flowing from a 15 inch diameter clay pipe located in the left channel wall downstream of the dam. This clay pipe probably provides surface drainage for the road above the left abutment.

3.2 Evaluation

Based on the visual inspection, it was possible to assess the dam as being in fair condition. The following features which could influence the future condition or stability of the dam were identified.

1. Severe deterioration of the main spillway aprons can result in undermining at the downstream toe of the spillway.

2. Deterioration of the auxiliary spillway lower apron, even though not severe at the present time, can present a stability problem in the future.

3. Trees growing on the downstream slope of the earth embankment next to the auxiliary spillway contribute to the deterioration of the spillway apron and walls.

4. Erosion of the crest and downstream and upstream slopes of the earth embankment could become worse and compromise the integrity of the earth dike.

SECTION 4 OPERATIONAL PROCEDURES

4.1 Regulatory Procedures

The four sluice gates are opened approximately 3/4 of the way when the backwater of Hanover Pond causes flooding of upstream developments. Attempts are made to limit the flow downstream to the sewage treatment facility, but only when upstream flooding is not a problem.

4.2 Maintenance of Dam

Vegetation on the dam is cut with a sickle periodically during the summer. Maintenance to the dam itself is to be accomplished on an as-needed basis, however some much-needed maintenance has been neglected. A gradual gravel upstream approach to the spillways is maintained to allow a crane to move across the dam during periods of low water levels and remove debris from the trash racks and from the downstream toe of the dam.

4.3 Maintenance of Operating Facilities

Maintenance to the sluice gates is on an as-needed basis. The most recent maintenance was during the summer of 1978 when one gate stem was replaced and at which time a crane removed debris from the trash racks and downstream toe of the dam.

4.4 Description of Any Formal Warning System In Effect

No formal warning system is in effect. In the event of a large storm, police check the dam periodically and would warn downstream residents in the event of an emergency. However, there appears to be no set criteria for when the police should or should not check the dam.

4.5 Evaluation

The operational procedures for the dam are generally adequate, however, the maintenance procedures need improvement, most notably in the area of the downstream concrete spillway aprons. A formal program of operation and maintenance procedures should be implemented, including documentation to provide complete records for future reference. Also, a formal warning system should be developed and implemented within the time frame indicated in Section 7.1.c. Remedial operation and maintenance recommendations are presented in Section 7.

SECTION 5: HYDRAULIC/HYDROLOGIC

5.1 Evaluation of Features

a. General - The dam is a low storage - high spillage type project. The relationships of peak inflow to peak outflow, and of peak outflow to spillway capacity, are somewhat similar to a run-of-the-river type dam.

b. Design Data - No computations could be found for the original dam construction. There was a great deal of controversy from 1938 to 1950 pertaining to the inadequate spillway capacity, with the result being the construction of an auxiliary spillway in 1950. Numerous figures on required spillway capacities and related information are included in the voluminous correspondence during this 12 year period.

c. Experience Data - Flooding upstream caused by the backwater created by the dam has been a problem in the past. At times it has been necessary to ferry residents from their homes in boats due to the flooding. Recently, large flows in the Quinnipiac River downstream of the dam have caused substantial damage, most notably to a trailer park inhabited largely by elderly residents. There is every reason to expect increased flows due to a failure of the dam would cause a great deal more damage and possible loss of life in those same downstream residential areas.

d. Visual Observations - It appears unlikely that the spillways would become blocked due to debris. The sluice gates would be subject to blockage due to debris on the trash racks, as is to be expected.

e. Test Flood Analysis - The test flood for this high hazard, intermediate size dam is equivalent to the Probable Maximum Flood (PMF). Based upon "Preliminary Guidance for Estimating Maximum Probable Discharges", dated March, 1978, peak inflow to the reservoir is 74,700 cfs (Appendix D-8); peak outflow (Test Flood) is 72,900 cfs with the dam (dike) overtopped 6.3 feet (Appendix D15). Based upon our hydraulics computations, the collective spillway capacity is 4,600 cfs, which corresponds to roughly 6 percent of the Test Flood peak outflow.

Utilizing the April, 1978, "Rule of Thumb Guidance for Estimating Downstream Dam Failure Hydrographs", the peak failure outflow from the dam breaching would be 31,700 cubic feet per second. This would result in a 12 foot wave immediately downstream of the dam at the retail boat store. Further downstream are a few isolated structures and a sewage treatment plant. Approximately two miles downstream from the dam, the Quinnipiac River flows through the community of Yalesville, where extensive flooding occurred at a trailer park due to the storm of January 25, 1979.

SECTION 6: STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability

a. Visual Observations - The visual inspections did not disclose any immediate stability problems. The horizontal aprons of the auxiliary spillway and particularly of the main spillway are in poor condition. Undermining of the horizontal apron of the main spillway is probably the primary cause for its deterioration. A gap between the horizontal and inclined aprons of the main spillway makes the inclined apron susceptible to undermining, which could lead to instability of the main spillway.

b. Design and Construction Data - There is not enough design and construction data available to permit an in-depth assessment of the structural stability of the dam.

c. Operation Records - Since the collapse of the original auxiliary spillway, and its subsequent reconstruction, there has been no record or indication of any instability. The left abutment structure and the main spillway have not had any indications of structural instability since constructed in their present configuration.

d. Post Construction Changes - Since the latest construction of the dike and spillways, no significant post construction changes have been effected.

e. Seismic Stability - The dam is in Seismic Zone 1, and, according to the Recommended Guidelines, need not be evaluated for seismic stability.

SECTION 7: ASSESSMENT, RECOMMENDATIONS AND REMEDIAL MEASURES

7.1 Dam Assessment

a. Condition - Based upon the visual inspection of the dam and its past performance, the dam appears to be in fair condition. No evidence of immediate structural instability was observed in the abutments, spillways, or the earth dike. The primary areas requiring attention are the inadequate spillway capacity, the severely deteriorated spillway aprons, and the trees growing on the earth dike adjacent to the auxiliary spillway.

Based upon "Preliminary Guidance for Estimating Maximum Probable Discharges" dated March, 1978, peak inflow to the reservoir is 74,700 cubic feet per second; peak outflow (Test Flood) is 72,900 cubic feet per second with the dam overtopped 6.3 feet.

Based upon our hydraulics computations, the collective spillway capacity is 4,600 cubic feet per second, which is equivalent to approximately 6 percent of the Test Flood.

b. Adequacy of Information - The information available is such that an assessment of the condition and stability of the dam must be based solely on visual inspection, the past performance of the dam, and sound engineering judgement.

c. Urgency - It is recommended that the measures presented in Section 7.2 and 7.3 be implemented within 1 year of the owner's receipt of this report.

d. Need for Additional Information - There is a need for more information as recommended in Section 7.2.

7.2 Recommendations

1. Based upon the rough computations in Appendix D, the dam spillway capacity will be exceeded by the Test Flood. More sophisticated flood routing should be undertaken by hydrologists/hydraulics engineers to refine the Test Flood figures. A study should be undertaken and recommendations made to increase the spillway capacity based upon the refined Test Flood figures.

2. A registered professional engineer qualified in dam engineering should inspect the deteriorated spillway aprons and formulate recommendations for their reconstruction in such a manner that future severe deterioration will be averted. The engineer should also evaluate the present overall stability of the structure in light of its past stability problems. This evaluation should include a comprehensive search for as-built construction records to determine its composition.

7.3 Remedial Measures

a. Operation and Maintenance Procedures - The following measures should be undertaken within the time frame indicated in Section 7.1.c, and continued on a regular basis where applicable.

1. Round-the-clock surveillance should be provided by the owner during periods of unusually heavy precipitation. The owner should develop a formal warning system with local officials for alerting downstream residents in case of an emergency.

2. A formal program of operation and maintenance procedures should be instituted and fully documented to provide accuract records for future reference. These procedures should include the operation of the sluice gates at least twice yearly.

3. The low level sluice gates are opened by means of floor stands operated by a gasoline powered wrench. The wrench location should be quickly and easily reachable in the event of an emergency. A safe means of reaching the floor stands should be devised such that the sluice gates could be operated even should the left abutment by the floor stands be overtopped.

4. The trees adjacent to the auxiliary spillway should be removed, as well as those trees and debris in the downstream discharge channel.

5. The upstream left edge of the dike adjacent to the right auxiliary spillway wingwall should be filled to the elevation of the top of the wingwall and the resulting slope, as well as the rest of the upstream dike slope, should be protected with the appropriate rip rap.

6. Any eroded areas of the downstream dike slope should be filled and then, along with the crest of the dike, should be planted with grass for erosion protection.

7. A program of inspection of the dam by a registered professional engineer qualified in dam inspection should be instituted on an annual basis. The inspections should be technical in nature and should include the operation of the 4 sluice gates.

7.4 Alternatives

This study has identified no alternatives to the above recommendations and remedial measures.

APPENDIX

SECTION A: VISUAL OBSERVATIONS

VISUAL INSPECTION CHECK LIST

PARTY ORGANIZATION

PROJECT HARPER [illegible] DAM

DATE: DEC. 1, 1978

TIME: 1:00 PM

WEATHER: [illegible] 40°

W.S. ELEV. [illegible] U.S. _____ DN.S

PARTY:	INITIALS:	DISCIPLINE:
1. PETER [illegible]	PHH	CAHN ENGINEERS, INC.
2. CHARLES GOLDSMITH	CEG	CAHN ENGINEERS
3. TEL J. VEACH	TJV	CAHN ENGINEERS
4. GONZALO CASTRO	GC	GEOTECHNICAL ENGINEER, INC.
5. THOMAS KELLER	TK	GEOTECH. ENGINEER
6.		

	PROJECT FEATURE	INSPECTED BY	REMARKS
1.	LEFT STONE/CONCRETE ABUTMENT	PHH, CEG, GC, TK	
2.	EARTH DIKE EMBANKMENT	PHH, CEG, GC, TK	
3.	OUTLET WORKS AND [illegible]	PHH, CEG, GC, TK	
4.	MAIN AND AUXILIARY SPILLWAYS	PHH, CEG, GC, TK	
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			

PERIODIC INSPECTION CHECK LIST

PROJECT HANOVER FOLLY DAM DATE DEC. 7, 1978

PROJECT FEATURE [illegible] INSPECTED BY [illegible]

AREA EVALUATED	CONDITION
DAM EMBANKMENT	
Crest Elevation	[illegible]
Current Pool Elevation	[illegible]
Maximum Impoundment to Date	
Surface Cracks	[illegible]
Pavement Condition	[illegible]
Movement or Settlement of Crest	[illegible]
Lateral Movement	[illegible]
Vertical Alignment	[illegible]
Horizontal Alignment	[illegible]
Condition at Abutment and at Concrete Structures	GOOD
Indications of Movement of Structural Items on Slopes	N/A
Trespassing on Slopes	N/A
Sloughing or Erosion of Slopes or Abutments	N/A
Rock Slope Protection-Riprap Failures	N/A
Unusual Movement or Cracking at or Near Toes	[illegible]
Unusual Embankment or Downstream Seepage	[illegible]
Piping or Boils	[illegible]
Foundation Drainage Features	NONE
Toe Drains	N/A
Instrumentation System	NONE OBSERVED

PERIODIC INSPECTION CHECK LIST

PROJECT HANOVER DAM DATE DEC 7, 1978

PROJECT FEATURE EARTH DIKE EMBANKMENT BY PMH, CRG, GC, TK

AREA EVALUATED	CONDITION
DIKE EMBANKMENT	
Crest Elevation	
Current Pool Elevation	87.1
Maximum Impoundment to Date	
Surface Cracks	NONE OBSERVED
Pavement Condition	N/A
Movement or Settlement of Crest	NONE OBSERVED
Lateral Movement	NOT DISCERNABLE
Vertical Alignment	TOO IRREGULAR TO JUDGE
Horizontal Alignment	TOO IRREGULAR TO JUDGE
Condition at Abutment and at Concrete Structures	EROSION AT TOP OF U/S AND D/S SLOPES NEXT TO RIGHT AUXILIARY SPILLWAY WALL
Indications of Movement of Structural Items on Slopes	NA
Sloughing or Erosion of Slopes or Abutments	EROSION WHERE TREE WAS AT WATER LINE ON U/S SLOPE AND ADJACENT TO AUX. SPILLWAY
Rock Slope Protection-Riprap Failures	NONE OBSERVED - EROSION OF U/S SLOPE AT WATER LINE 1-2'
Unusual Movement or Cracking at or Near Toes	NONE OBSERVED
Unusual Embankment or Downstream Seepage	NONE OBSERVED
Piping or Boils	NONE OBSERVED
Foundation Drainage Features	NONE KNOWN
Toe Drains	NONE KNOWN
Instrumentation System	NONE KNOWN
Trespassing on Slopes	FOOT PATHS AND VEHICLES ON U/S SLOPE - VEHICLE RAMP ON U/S SLOPE

PERIODIC INSPECTION CHECK LIST

PROJECT [illegible] DATE Dec 1 1982

PROJECT FEATURE OUTLET WORKS STRUCTURE BY WH, CRG, JGK

AREA EVALUATED	CONDITION
OUTLET WORKS-OUTLET STRUCTURAL AND OUTLET CHANNEL	
General Condition of Concrete	GOOD
Rust or Staining	[illegible]
Spalling	NONE OBSERVED
Erosion or Cavitation	NONE OBSERVED
Visible Reinforcing	NONE OBSERVED
Any Seepage or Efflorescence	NONE OBSERVED
Condition at Joints	GOOD
Drain Holes	[illegible] 15 inch DIA. DRAIN U/S 1 KM ROADWAY
Channel	
Loose Rock or Trees Overhanging Channel	TREES ON LEFT SIDE OF U/S CHANNEL
Condition of Discharge Channel	GOOD
GATE MECHANISMS	GOOD CONDITION - APPEARS WELL MAINTAINED

PERIODIC INSPECTION CHECK LIST

PROJECT HANOVER [illegible] DAM DATE DEC. 7, 1978

PROJECT FEATURE MAIN AND AUXILIARY SPILLWAYS BY MACKEREL, INC.

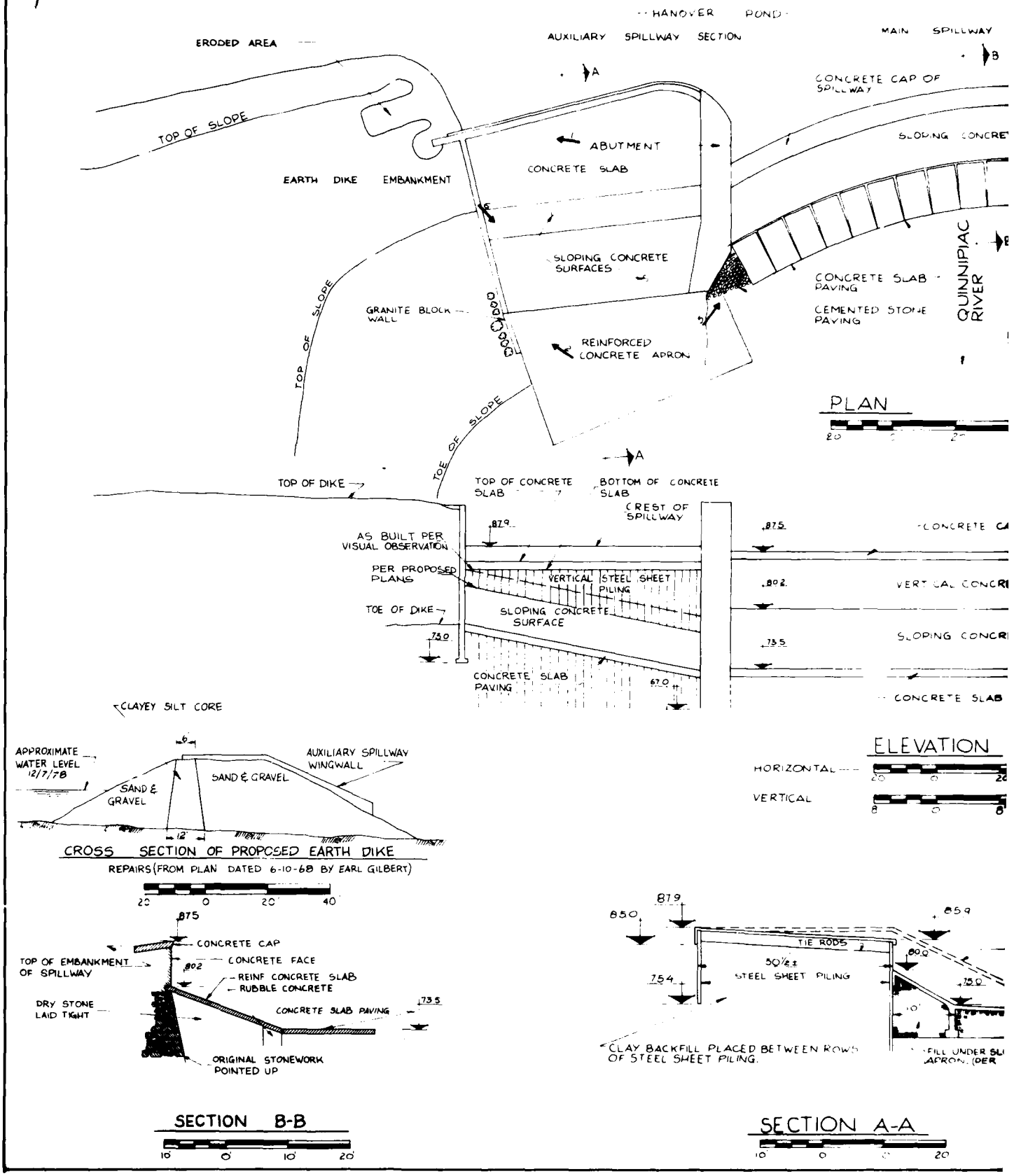
AREA EVALUATED	CONDITION
OUTLET WORKS - SPILLWAY WEIR, APPROACH AND DISCHARGE CHANNELS	
a) Approach Channel	GOOD
General Condition	
Loose Rock Overhanging Channel	
Trees Overhanging Channel	
Floor of Approach Channel	
b) Weir and Training Walls	
General Condition of Concrete	GOOD
Rust or Staining	NONE OBSERVED
Spalling	MINOR AT CENTER JOINT
Any Visible Reinforcing	NONE OBSERVED
Any Seepage of Efflorescence	NONE OBSERVED
Drain Holes	NONE OBSERVED
c) Discharge Channel(s)	
General Condition	FAIR
Loose Rock Overhanging Channel	NONE
Trees Overhanging Channel	TREES ADJACENT TO RIGHT WALL OF AUX. SPILLWAY ON DIKE EMBANKMENT
Floor of Channel	TREES ON BOTH SIDE OF CHANNEL
Other Obstructions	
UPPER APRON	GOOD
LOWER APRON	POOR. CRACKED W/ EXPOSED REINFORCING. MAIN SPILLWAY APRON HAS PIECES MISSING.

APPENDIX

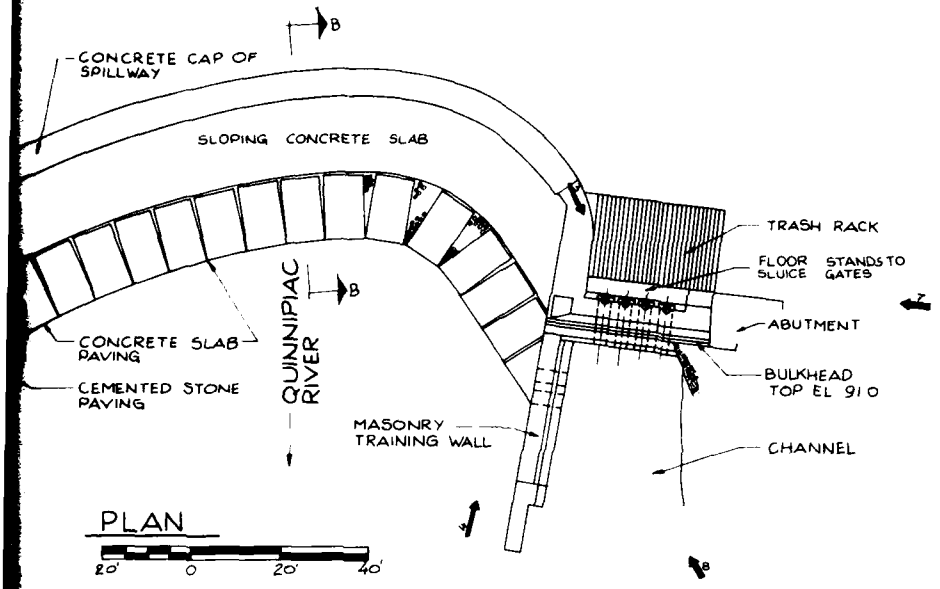
SECTION B: EXISTING DATA

APPENDIX

SECTION B: EXISTING DATA
HANOVER POND DAM

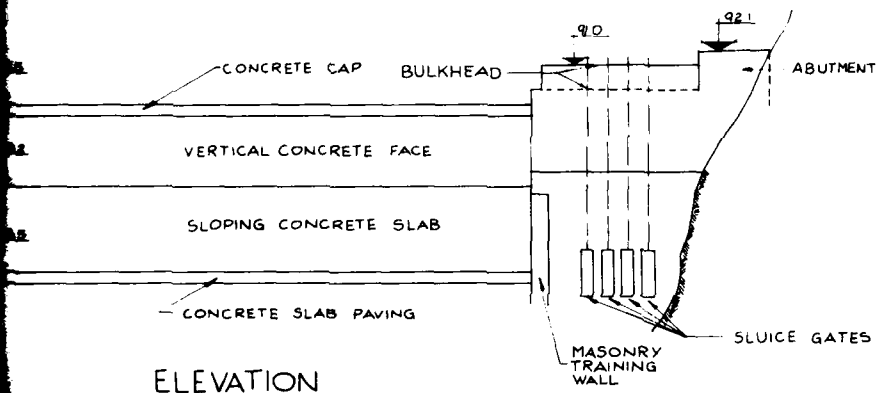

HANOVER POND
AUXILIARY SPILLWAY SECTION
MAIN SPILLWAY
ERODED AREA
TOP OF SLOPE
EARTH DIKE EMBANKMENT
ABUTMENT
CONCRETE SLAB
CONCRETE CAP OF SPILLWAY
SLOPING CONCRETE SURFACES
GRANITE BLOCK WALL
FLOOD LT.
REINFORCED CONCRETE APRON
CONCRETE SLAB PAVING
CEMENTED STONE PAVING
QUINNIPIAC RIVER
PLAN
TOP OF DIKE
TOP OF CONCRETE SLAB
BOTTOM OF CONCRETE SLAB
CREST OF SPILLWAY
AS BUILT PER VISUAL OBSERVATION
PER PROPOSED PLANS
VERTICAL STEEL SHEET PILING
TOE OF DIKE
SLOPING CONCRETE SURFACE
CONCRETE SLAB PAVING
CLAYEY SILT CORE
ELEVATION
HORIZONTAL
VERTICAL
APPROXIMATE WATER LEVEL 12/7/78
SAND & GRAVEL
SAND & GRAVEL
AUXILIARY SPILLWAY WINGWALL
CROSS SECTION OF PROPOSED EARTH DIKE
REPAIRS (FROM PLAN DATED 6-10-68 BY EARL GILBERT)
CONCRETE CAP
CONCRETE FACE
TOP OF EMBANKMENT OF SPILLWAY
REINF CONCRETE SLAB
RUBBLE CONCRETE
DRY STONE LAID TIGHT
CONCRETE SLAB PAVING
ORIGINAL STONEWORK POINTED UP
TIE RODS
50'x2.5 STEEL SHEET PILING
CLAY BACKFILL PLACED BETWEEN ROWS OF STEEL SHEET PILING.
SECTION B-B
SECTION A-A

MAIN SPILLWAY SECTION



PLAN

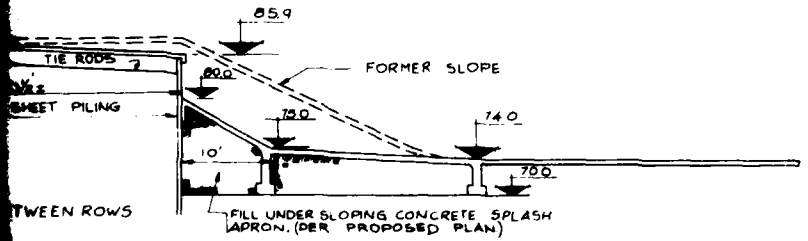
20' 0 20' 40'



ELEVATION

IZONTAL 20' 0' 20' 40'

TICAL 8' 0' 8' 16'



CTION A-A

0 10' 20

FOR PLAN, ELEVATIONS AND SECTIONAL VIEWS:

1 MAIN SPILLWAY SECTION FROM PLAN ENTITLED "HANOVER POND DAM" DATED MARCH 21, 1941.
2 AUXILIARY SPILLWAY SECTION FROM PLAN FOR PROPOSED NEW SPILLWAY DATED MAY, 1962
3 EARTH DIKE PLAN AND ELEVATION FROM CAHN ENGINEERS FIELD SURVEY OF DEC 7, 1978, SECTION AS NOTED

NOTES

1 THIS PLAN IS A COMPILATION OF ROUGH FIELD SURVEY AND EXISTING PLANS FOR THE ORIGINAL DAM AND SPILLWAY AND FOR THE THEN PROPOSED AUXILIARY SPILLWAY AND DIKE REPAIRS AS DRAWN BY THE CITY OF MERIDEN ENGINEERING DEPARTMENT AND EARL GILBERT NOT ALL TOPOGRAPHIC AND STRUCTURAL FEATURES ARE NECESSARILY IDENTIFIED ON THIS PLAN

2 ELEVATIONS TAKEN FROM MERIDEN CITY DATUM ELEVATIONS SHOWN ON ONE EXISTING PLAN AND A DATUM CONVERSION TO MEAN SEA LEVEL PROVIDED BY THE CITY OF MERIDEN.

3 ← 5 PHOTO NUMBER AND DIRECTION

CAHN ENGINEERS INC WALLINGFORD, CONNECTICUT ENGINEER	U S ARMY ENGINEER DIV NEW ENGLAND CORP OF ENGINEERS WALTHAM, MASS

NATIONAL PROGRAM OF INSPECTION OF NON-FED DAMS

HANOVER POND DAM

QUINNIPIAC RIVER MERIDEN, CONNECTICUT

DRAWN BY	CHECKED BY	APPROVED BY	SCALE AS NOTED	
HN	CRG	PMH	DATE FEB 1979	PAGE 8-1

LIST OF SELECTED EXISTING PLANS

February 27, 1939
No Title
Sheet Shows Plan of Dam, Profile and Section of Dike

"Plans & Cross Sections for
Repairs to Hanover Dam"
Meriden, Connecticut
City Engineer's Office
October 1939

"Repairs to Present Spillway"
"Typical Section"
C.P. Prann, City Engineer
Revised August 20, 1940

Hanover Pond Dam
Meriden, Connecticut
"Plan, Elevation and Spillway Section"
March 21, 1941

"Profile on Masonry Dam-Spillway &
Earth Dam"
City of Meriden Engineering Department
April 2, 1941

"Plans For Proposed New Spillway
at Hanover Pond"
City Engineer's Office
May 1962

"Sluice Gate Installation
Diversion and Handling of Water Flow".
City of Meriden
March 16, 1968

"Details of Proposed Repairs
to Earth Dike at Hanover Pond".
Earl Gilbert-Engineer
June 10, 1968

SUMMARY OF DATA AND CORRESPONDENCE

DATE	TO	FROM	SUBJECT	PAGE
June 12, 1963	Files	Water Resources Comm. Supervision of Dams	Inventory Data	B-5
July 16, 1938	Conn. Gas Products Inc. South Meriden, Conn.	Clarence M. Blair Board of Civil Eng. 3rd Congressional Dis.	Formal notice to owner to place dam in a safe condition Encl.-cross sec. sketch of dam	B-6
March 15 1940	Francis R. Danaher Mayor, City of Meriden	Clarence M. Blair	Hydrologic data showing inadequacy of spillway	B-10
March 21, 1940	Lieut. Col. J.S. Bragdon District Engineer U.S. Engineer Office Providence, R.I.	Clarence M. Blair	Hydrologic data and reasons for specific spillway design	B-13
May 13, 1941	Files	New Haven County Superior Court	Louis Curran et. Al. vs. Conn. Gas Products court case arising out of failure of dam	B-15
May 26, 1941	Files	Minutes of hearing requested by Meriden Mayor Danaher before State Board of Supervision of Dams	Hanover Dam- Finding of Facts	B-19
June 19, 1941	Files	Sanford H. Wadhams Chairman, State Board of Supervision of Dams	Meeting of Board of Supervision of Dams	B-23

Note: Additional correspondence not included herein is available from the State of Connecticut and City of Meriden files.

No. ME 9

WATER RESOURCES COMMISSION
SUPERVISION OF DAMS
INVENTORY DATA

Long 72-49.6
Lat 41-31.2

Inventoried By WPS

Date 12 JUNE 1963

Name of Dam or Pond HANOVER POND CT-00134

Code No. QO 234

Nearest Street Location ROUTE 71

Town MERIDEN WATERSHED

U.S.G.S. Quad. MERIDEN

95 sq mi

Name of Stream QUINNIPIAC RIVER

Built 1915

Owner CITY OF MERIDEN City & Co.

Address MERIDEN DCL

Hartford

HC 7/73

Pond Used For RECREATION

Dimensions of Pond: Width 1000 FEET Length 2500 FEET Area ~~60~~ 76 ACRES

Total Length of Dam 100 FEET Length of Spillway 80 FEET

Location of Spillway EAST END OF DAM

Height of Pond Above Stream Bed 10 FEET

Height of Embankment Above Spillway 6 FEET

Type of Spillway Construction CONCRETE APRON

Type of Dike Construction CONCRETE

Downstream Conditions QUINNIPIAC RIVER, ROUTE 70

Summary of File Data SIX FILE FOLDERS

B-5

Remarks REPAIRS MADE IN 1962, DAM APPEARS SOUND.

Would Failure Cause Damage? YES Class B

Copy

July 16, 1938

Connecticut Gas Products, Inc.
South Meriden, Conn.

Gentlemen:

I hereby serve this formal notice on the Connecticut Gas Products, Inc., the owner of the Hanover Dam across the Quinnipiac River, at South Meriden, to place this dam in a safe condition.

I would respectfully refer you to Chapter 171, Sections 3056 to 3063, inclusive, Connecticut General Statutes of 1918 (Title XXX, Chapter 180, Sections 3001 to 3008, inclusive, Connecticut General Statutes, Revision of 1930). A booklet containing a copy of the laws and regulations regarding inspections of dams by the Board of Civil Engineers is submitted herewith.

Under date of May 16, 1938, I received an application in writing from the State Highway Commissioner in which the stability of this dam was questioned, and calling to my attention that, should the dam fail, damage would be done to the highway bridge (Route #70) over the Quinnipiac River a short distance south of the dam.

Acting under Section 3058 (General Statutes of 1918) I forthwith visited the dam on June 2, 1938. At that time the reservoir was nearly filled, so only a preliminary examination could be made. I advised your Mr. Fouser to keep the blow off gates opened, and when the reservoir was down at least six feet to notify me, so that a complete examination could be made. Mr. Fouser carried out these instructions and advised me about June 20, that the reservoir level had dropped the required amount. At that time I was an expert witness in an important case in Superior Court of Fairfield County, and no time was available from that case until after June 27. Heavy rains June 26, 27 and 28, a total of nearly 5 inches, raised the level of the reservoir and delayed the inspection.

I was again notified by Mr. Fouser on July 8, 1938 and arranged to make the inspection July 12, 1938. Acting within the authority of the Statutes, I called in Mr. Shepard B. Palmer of Norwich, Member of the Board of Civil Engineers from the Second Congressional District, for consultation and advice.

At the time of the inspection, the reservoir was practically empty. The blowoff gates were open, but measures were being taken to close these gates under an alleged order of the Health Officer.

Hanover Dam has been in existence at this site for a long period of years. From the inspection it appeared that the original dam was about 8 feet high above the bed of the stream. The downstream face of this original dam is dry rubble sandstone masonry consisting of large stone well laid with close joints. It is probable that this substantial masonry wall was backed up with an earth embankment.

It further appeared from this inspection that this original masonry dam was raised about two feet, as indicated by two lines of heavy 12" x 12" squared timbers, that show above the masonry. These timbers were doweled together and were apparently backed up by a mortar made with Rosendale cement. Both of these timbers are in a very bad state of decay.

The dam was evidently raised again. This time a timber crib was constructed on the old dam. On the downstream side this crib was faced with six heavy timbers, about 12" x 12", doweled together, and tied across to the back timbers. Some of these timbers are partially decayed.

Another raise of about 12 inches was made later when an inclined concrete slab about 12 inches in thickness was placed on the top of the dam.

There is an embankment on the upstream side of the dam, the top of the embankment being substantially 3 feet below the spillway level.

The total height of the present dam to spillway level above the river bed downstream is 17 feet.

As to the foundations of this dam, there is an outcrop of red sandstone at the easterly side of the blowoff channel. There are no rock outcrops in the river bed. At the easterly half of the spillway downstream, a rather large pocket has been formed, averaging about 4 feet in depth. There is a timber cribwork in this pocket. In front of the westerly half of the spillway there are evidences of timber supports for an inclined deck apron extending southerly from the dam. It is probable that this apron originally extended the full length of the spillway.

In plan, the spillway section of the dam is a curve, concave toward the south, with a straight section at its easterly end. Heavy masonry abutments are located at both ends of the spillway. The blowoff gates are located at the southerly end of a channel easterly of the spillway.

The total length of the spillway is 171 feet. The masonry wall over the gate bulkhead is 2 feet higher than the spillway, with a length of about 43-1/2 feet. The top of the easterly abutment is 3 feet above the spillway, and the westerly abutment is 4.3 feet above the spillway. From information offered by a former employee at this factory site, the high water mark of this reservoir is about 40 inches above the spillway.

From the westerly abutment westerly, a heavy earth embankment extends to the forebay channel. This channel is about 20 feet in width and extends southerly about 400 feet. At the southerly end of this channel new creosoted wood gates have been installed comparatively recently.

The area of the present watershed tributary to this dam is about 83 square miles. I estimate that a height of 40 inches of water over the spillway means a discharge of about 44 cubic feet per second per square mile. The total freeboard is about 4.3 feet. A discharge with this depth of water over the spillway means a discharge of about 67 cubic feet per second per square mile. The maximum flood discharge for a watershed of this comparable area is about 169 cubic feet per second per square mile. The large pondage is of great value in controlling the high flows. I am of the opinion that quite frequently there is considerable depth of water passing over the spillway.

B-7

As a result of my inspection, I have concluded that there are two particular items that make this dam such a hazard that the breaking away of same would endanger life and property.

(1) The conditions of the two lines of timber above the masonry wall and the material backing up these timbers are such that a structural weakness could easily develop. The timbers are no longer capable of acting as a support and the material in back of these timbers is of poor quality.

(2) The conditions in the river bed south of the dam are very hazardous. At the easterly half of the spillway the discharge from the spillway has a tendency to scour at the toe of the dam. The power of this discharge is indicated by the fact that all the stone fill and timber apron have been washed out by these high flows. With frequent large depths of water passing over the spillway, the scouring action is great.

These two hazards indicate that the dam might break away either by a gradual washing out of the embankment and walls back of the face timbers, or by overturning caused by scouring of the material at the toe of the dam.

RECOMMENDATIONS

In accordance with the authority provided in the General Statutes, I hereby order the following repairs made so as to place it in a safe condition:

(1) Cut out the two lines of timber above the masonry and replace with cement posts and rubble masonry facing, or some other practical and acceptable method.

(2) Replace any other timber above these two lines wherever necessary.

(3) Provide the necessary timber supports and replace the downstream inclined wooden apron. Fill in between the timber supports with stone, which can be obtained from the river bed southerly of the dam. Use heavy planking for the apron, and have the top of this apron at the dam at substantially the level of the third timber above the old masonry dam.

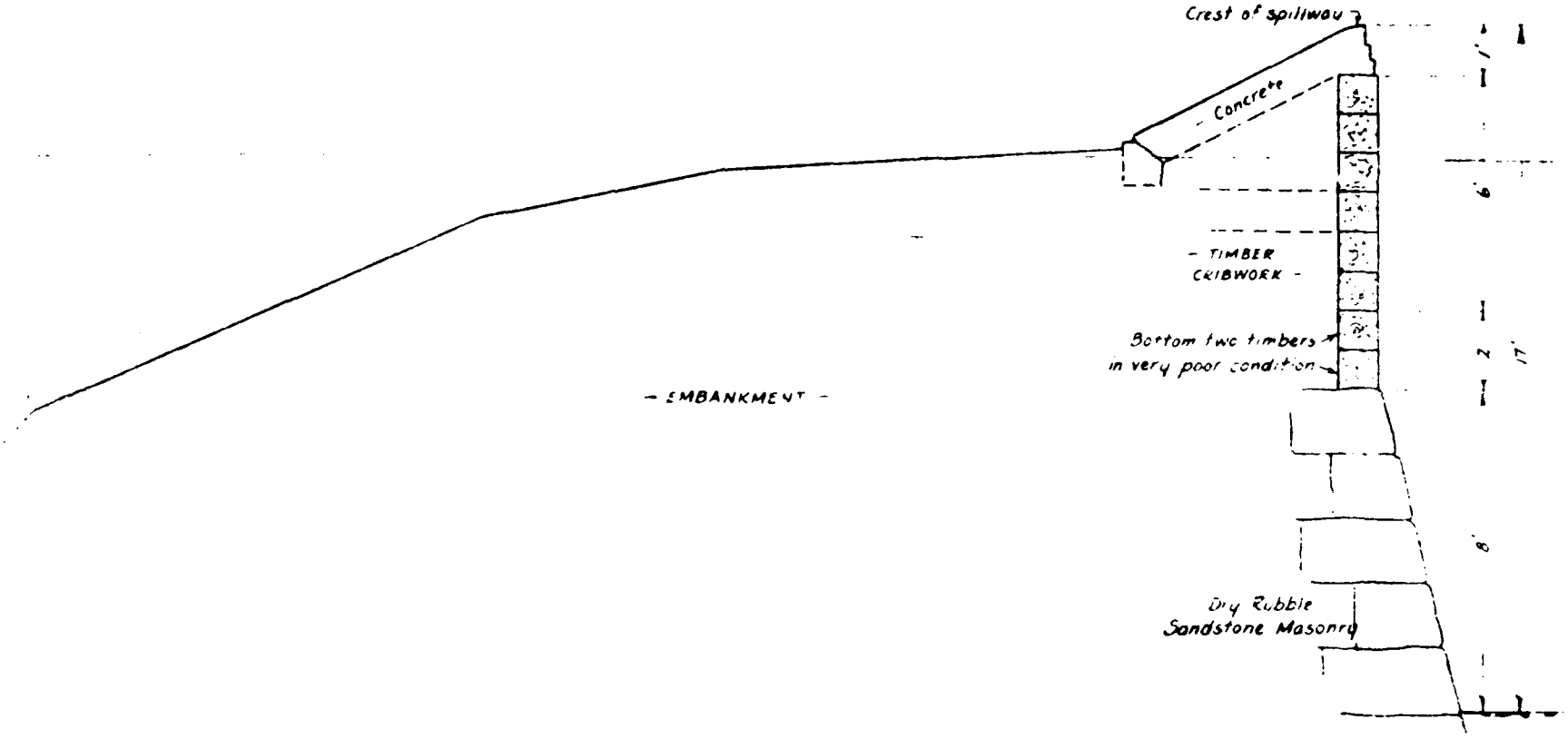
These recommendations represent the minimum amount of work that can be done to place this dam in a reasonably safe condition. You should take immediate steps to engage a competent engineer, registered in Connecticut, or an experienced contracting organization with a registered engineer, to make these necessary repairs.

By letter dated July 13, 1938, I advised you that the gates might be closed and the reservoir filled to a level about 4 feet below the spillway level, and that this level should be maintained substantially as ordered up to October 1, 1938. Unless the repairs as outlined are completed by that date, consideration must then be given to opening the blowoff gates, and drawing out the water entirely.

I will be pleased to have you advise me of the receipt of this report. Plans for repairs are to be submitted for my approval. I assure you that I will cooperate in any possible way to expedite these repairs.

Respectfully submitted,
/s/ C. M. Blair
Member, Board of Civil Engineers
Third Congressional District

CMB:GRB



MAXIMUM CROSS SECTION OF DAM
HANOVER LAKE
TOWN OF MERIDEN, CONN.

Scale $\frac{1}{4}$" = 1'

July 16, 1938

B-9

B-382

Hon. Francis R. Danaher, Mayor
City Hall
Meriden, Conn.

P. O. Box 236, New Haven
March 15, 1940

Dear Mayor Danaher:

Thank you for your letter of March 10th. You speak of my being "lenient" in the matter of the Hanover Dam. I prefer the word "cooperative", and that I have endeavored to be, during all the discussions that have been had. However, when I have been commissioned by the executive of the State to perform certain functions as per Statutes, I must discharge these to the best of my ability. I am sure that the figures presented in my letter of March 5th showing computed discharges, show very clearly that I considered all factors very carefully, and even then the computed discharge was nearly double (11,000 cubic feet per second) the amount the dam as reconstructed will discharge. There is no question in my mind but that the discharge capacity is woefully inadequate.

As to the watershed area, the net area of 83 square miles is correct, and does not include the Broad Brook watershed area. The total gross area tributary to Hanover Dam is 95.0 square miles. Diversions from this watershed are as follows:

Plainville	0.5	sq.	miles
New Britain	2.4	"	"
Southington	2.3	"	"
New Haven (Prospect)	1.7	"	"
Meriden (Broad Brook)	4.7	"	"
	11.6	"	"
Net Area	83.4	"	" - figure used 83 sq. miles

The only reason that I did not base my computations on the gross area of 95 square miles instead of the net area, was on account of the comparatively flat topography in the Quinnipiac River watershed. Undoubtedly at times of large flood some of the diverted areas will discharge into Quinnipiac River and add their volume to the runoff of the 83 square miles.

B-10

Referring to your quotation from Col. Bragdon's report dated Aug. 19, 1940, I must ask you to read the whole paragraph - "For determining spillway capacities for smaller dams where failure will not necessarily result in loss of life or severe property damage, the requirements are not as severe, and vary with the individual case. Usual conditions simulating the worst storm in New England, with an increase in the experienced runoff factor, are assumed to determine the spillway design flood which is routed through the surcharge storage to determine the length and surcharge of the spillway....."

The statement in this quoted paragraph is substantially the way we arrived at our requirements for Hanover Dam. All factors were carefully weighed. If we had followed the government method in its entirety, the computed discharge would be 18,000 cubic feet per second.

In regard to your statement - "We do not feel that there is any danger of loss of life and little or no danger of loss of property should the Hanover Dam or its abutments fail" - I am really surprised at such a statement in view of the well known conditions southerly of the dam.

My data indicates that there were several dams southerly of Hanover Dam when your Broad Brook Reservoir was constructed in 1914. These were power dams then operated by the following owners:

1. The Jennings & Griffin Mfg. Co.
2. C. I. Yale Mfg. Co.
3. International Silver Co.
4. R. Wallace & Sons, Mfg. Co.
5. Borough of Wallingford

Some of these properties are not now in use, but there certainly are potential dangers in the Quinnipiac River if the Hanover Dam should fail. Consider only the 3rd and 4th property mentioned. How can anyone say that the International Silver Company and R. Wallace & Sons Mfg. Co. would not suffer damage from failure of Hanover Dam?

What about highway damage if Hanover Dam should fail? The first complaint I received was from the State Highway Department in 1938 in which concern was expressed on the condition of Hanover Dam and how a failure would damage the bridge and highway at South Meriden. The new Hall Avenue bridge at Wallingford, and several other highway crossings might also suffer damage. Then again, please remember that lawsuits are now pending in regard to damage from the 1938 failure. I also have knowledge that some owners along the river are contemplating suits for damages from the 1938 failure.

You refer only to the spillway or its abutments in speaking of possible failure. You should remember that the earth embankment westerly of the west abutment is also subject to failure.

As matters now stand, I want to renew my offer of cooperation. However, we are not in agreement on several fundamental matters in connection with Hanover Dam. I cannot yield on these matters when all my engineering knowledge and training indicates that the facts are clearly defined, and I would be guilty of violating my commission if I did not insist on the dam being constructed in accordance with the Statutes.

I have certain ideas of what might be done with Hanover Dam that might bring it up to my requirements, but any change would mean additional expense to you. I would not care to discuss these matters except with the entire Board of Supervision of Dams.

If your engineer has any proposals to make regarding the reconstruction of this dam to allow for ample spillway capacity, I will be pleased to receive them. I think he must first, however, convince himself that the Statutes clearly apply to this dam.

I will be pleased to discuss this matter with you further, or if you prefer, you may request a meeting with the whole Board. In any event, I hope to hear from you in a few days.

Very truly yours,

C M Olan

Member, State Board of Supervision of Dams

MB:GRB
cc-S.H.Wadhams ✓
S.B.Palmer

P. O. Box 230, New Haven
March 21st, 1940

Lieut. Col. J. S. Bragdon
District Engineer
U. S. Engineer Office
Providence, R. I.

Dear Sir:

The City Engineer of Meriden, Connecticut, has handed me a copy of your letter dated January 5, 1940 addressed to Mr. V. J. Sullivan, Administrator, W.P.A., in which you stated that the project for the reconstruction of Hanover Dam for the City of Meriden was not approved upon the basis of the data submitted.

The Meriden authorities have requested me to write you and review the data in regard to this proposed reconstruction that has been considered and the orders issued by me, as a member of the State Board of Supervision of Dams.

The condition of this dam first came to my attention in 1938 when a complaint was made by a lower riparian owner in which the stability of this structure was questioned. In accordance with the General Statutes, an order was issued by me to the then owner, Connecticut Gas Products, Inc., to place this dam in a safe condition. Certain data collected at that time is pertinent to the present problem.

Watershed area - 83 square miles (net)
Length of spillway - 171 feet
Freeboard at west abutment - 4.3 feet
Additional spillway discharge over bulkheads at sluice gates - length 43.5 feet. Level is 2 feet higher than present spillway
Height of dam, river bed to top of spillway - 17 feet
Maximum high water as reported by an old resident in this vicinity - 40" - 67 cu.ft./sec./sq.mi.

The maximum cross section of the dam prepared at the time of my investigation is submitted herewith. This cross section indicates the successive raises of this dam over a long period of years. My order at that time was for certain repairs to place the dam in a safe condition, as follows:

1. Cut out the two lines of timber above the masonry and replace with cement posts and rubble masonry facing, or some other practical and acceptable method.

2. Replace any other timber above these two lines wherever necessary.

3. Provide the necessary timber supports and replace the downstream inclined wooden apron. Fill in between the timber supports with stone, which can be obtained from the river bed southerly of the dam. Use heavy planking for the apron, and have the top of this apron at the dam at substantially the level of the third timber above the old masonry dam.

In the flood which accompanied the hurricane of September, 1938, the embankment that formed the easterly side of the old forebay channel which extended from the westerly end of the dam southerly, 20 feet wide and about 400 feet long, was overtopped and failed.

The dam is now owned by the City of Meriden. The City of Meriden replaced the washed out portion of the dam, at its westerly end, with a heavy earth embankment

Sanford H. Wadhams, Chairman of our Board, at the dam November 23, 1939, the three recommendations, that I had previously made, as referred to above, were thoroughly discussed. I further advised Mayor Danaher that if the elevation of the crest of the spillway was permanently lowered three feet, thereby increasing the depth of the spillway trough, I would issue a permit authorizing construction of the spillway in accordance with the three recommendations with the modification of this lower spillway.

My reasons for accepting the design with the spillway lowered three feet were as follows:

(1) The spillway as modified would be capable of passing water at the rate of about 11,000 cu. ft. per second = 132 cubic feet per second per square mile. This is at least double the capacity of the old spillway.

(2) The maximum flood flow, prior to the 1938 hurricane, according to the best information available, was about 67 cubic feet per second per square mile. In the 1938 hurricane flood September 21, 1938, the nearest government gauging station on the Quinnipiac River less than two miles southerly of Hanover Dam recorded a maximum discharge of 5,140 cubic feet per second = 46 cubic feet per second per square mile.

(3) The Quinnipiac River has a comparatively slow watershed run-off. The tributary watershed of the Quinnipiac River is entirely within the limits of the State of Connecticut, the headwaters of this river being in the Towns of Bristol and Plainville. An examination of the Connecticut topographical sheets shows very clearly the large flat areas in this watershed. The run-off from this watershed is not affected by the additional load of melting snow from watersheds like the Housatonic and Connecticut Rivers which originate in northern New England, and in Canada.

(4) The large area covered by Hanover Lake and the surrounding flat territory allows for considerable ponding at times of heavy runoff which, in a way, smooths out the peak flows of comparatively short duration.

(5) The next dam southerly of Hanover Dam on the Quinnipiac River is the International Silver Company dam at Hall Avenue, Wallingford. At this dam, the length of the spillway is 175 feet, 9 inches. The total depth of the spillway trough is 7 feet, 5 inches. The maximum discharge in the September 1938 flood was about 80 cubic feet per second per square mile. This spillway is capable of passing water at the rate of about 11,000 cubic feet per second = 105 cubic feet per second per square mile.

I do not know what data has already been submitted to you for this project. I am pleased to give you data at hand and my reasons for my decision to issue a permit authorizing construction. It is possible that I have given you sufficient data so as to permit you to reconsider this project. I will be pleased to discuss this whole situation with you if you so desire. B-14

It is extremely desirable for all parties concerned that this dam be reconstructed, and I am interested, as a member of the State Board of Supervision of Dams, to cooperate in any possible way, to obtain a safe and adequate structure at this site.

Very truly yours,

/s/ C. E. Blair

CEB:GRB

Member, State Board of Supervision of Dams

Extracted from
Conn. Supplement
Vol. 9, 1940-1941
Pages 312-317, incl.

30-1-1

LOUIS CURRAN ET AL.

vs.

CONNECTICUT GAS PRODUCTS COMPANY, INC.

Superior Court New Haven County File No. 58500

The erosion of plaintiff's land and injury to property thereon by a great body of water suddenly released from a pond, resulted not from maintenance by the defendant of dams, bulkheads, gates and similar fixtures in such condition as to have constituted a nuisance, but from an act of God, which consisted of unprecedented rainfall.

MEMORANDUM FILED MAY 13, 1941.

Paul W. McMahon, and Lewis J. Somers, of Meriden for the Plaintiffs.

Bronson, Lewis, Bronson & Upson, of Waterbury, for the Defendant.

Memorandum of decision in action arising out of claimed failure properly to maintain dams, bulkheads and similar fixtures.

BOOTH, J. The action is to recover damages for injuries to plaintiff's real property and to personal property of which the plaintiff is alleged to have been the bailee, which damages are alleged to have been caused by the maintenance of a nuisance by the defendant. The nuisance is alleged to have consisted of the condition of the dams, bulkheads, gates and other appurtenant fixtures at the southerly end of Hanover Pond in the City of Meriden.

The obvious reason for basing the claim upon nuisance rather than negligence is that section 1680c of the 1935 Cumulative Supplement to the General Statutes provides in part that: "No action to recover damages for injury to the person, or to real or personal property, caused by negligence . . . shall be brought but within one year from the date of the act or omission complained of."

In the present case the act or omission complained of occurred on and prior to September 20, 1938, whereas the action was not instituted until January 20, 1940. The above statute was pleaded in defense of any claim based upon negligence, hence such defense would bar the plaintiff from recovery upon such ground. If then the plaintiff is entitled to recover at all it must be upon the theory of nuisance.

In addition to the above defense, the defendant has alleged that the injuries complained of by the plaintiff were caused by an act of God consisting of an extraordinary storm and unusual conditions of weather on September 19, 1938 and September 20, 1938 in and about the vicinity constituting the watershed of the Quinnipiac River at and above the dam referred to in the complaint, and at and above the

B-15

plaintiff's property, which resulted in causing unprecedented volumes of water to flow into and down the Quinnipiac River and over, across and past the land of the plaintiff, which unprecedented volumes of water were the sole cause of damage to the plaintiff's property.

This defense is denied by the plaintiff and the issues presented are, first, whether plaintiff's property was in fact injured on the date alleged, and, second, whether such injury was solely and proximately caused by an act of God. That the plaintiff's property was in fact injured on September 21, 1938, there can be no question. The evidence disclosed that at about 2 o'clock a.m. on that date a building and part of the land of the plaintiff, as well as certain personal property which the plaintiff claimed was in the building, were swept away and destroyed by a flood of water which came from the so-called Hanover Pond. Whether the defendant is legally liable to the plaintiff therefor depends upon whether such destruction was proximately due to its maintenance of a nuisance as alleged.

As previously stated, the nuisance is alleged to have consisted of the condition of the dams, bulkheads, gates and other appurtenant fixtures at the southerly end of Hanover Pond. These structures were in part, at least, located upon land of the defendant, and in the deed by which it acquired such land the defendant covenanted to maintain and keep them in repair. The claim of the plaintiff is that the defendant failed to thus keep and maintain them and that as a result of such failure the structures became and were a nuisance. The defendant claims that it did not fail in its duty to properly maintain the structures in question and that the condition thereof did not constitute a nuisance. It further claims that the condition of the structures was not a proximate cause of the plaintiff's damage. A nuisance arises from the creation or maintenance of a condition having a natural tendency to cause danger and inflict injuries. Gonchar vs. Kelson, 114 Conn., 262, 271; Stoto vs. Waterbury, 119 id. 14; Brook-Hall Dairy Co. vs. New Haven, 122 id. 321, 326; Hassett vs. Palmer, 126 id. 468, 476.

According to the evidence it appeared that the property of the defendant was acquired by it on August 27, 1937, and consisted of a tract of land approximately 300 feet in width and 660 feet in length upon which were factory buildings designed to permit the machinery therein to be operated by water power. The property was bounded on the south by Main Street in East Meriden and on the north by a large body of water known as Hanover Pond. This pond had been created more than 75 years ago by the building of a dam and embankments across the Quinnipiac River. The dam consisted of a substantial sandstone wall backed up by an earth embankment, which was topped by heavy squared timber upon which there was a concrete slab. The total width of the dam was 171 feet and its height from the downstream river bed to the top of the spillway was about 17 feet. To the east of the spillway was located what are known as blow-off gates. These gates consisted of a heavy wooden structure, 43 1/2 feet in width embedded in masonry abutments. At the bottom of this structure there were four wooden gates, each of which covered apertures three feet square. These gates operated upon iron cogs which were attached to upright timbers, and were designed for use in lowering the water in the pond when such was desired. Structurally these gates were in good condition on September 20, 1938. On that date two were entirely open, one was half-way open

and the fourth was partly open. When water began to rise to an alarming extent on September 20, 1938, the defendant endeavored by all reasonable means to completely open all of the aforesaid gates, but a flood of water, due to an unprecedented rainfall which had occurred on that and several days previously, had brought down into the pond debris, including logs, stumps of trees, shrubbery, and so forth, and deposited them against the north side of said gates in such manner and to such extent as to prevent any further opening thereof, and the inability of the defendant to open said gates was not due to any negligence on its part.

A heavy earth embankment extended westerly from the westerly abutment of the dam to a raceway or fore-bay channel, which raceway was designed to carry water from the pond through a penstock into the water wheel inside the factory building. This channel was about 20 feet in width. At the pond end of the channel there was a structure about 23 feet in width and about 20 feet in height, consisting of heavy wooden timbers embedded in masonry abutments. The purpose of this structure was to hold back the water from the pond and to release through four gates, similar to those before described, only such quantities of water as were desired to have flow through the raceway into the water wheel of the defendant's building. On September 20, 1938, these gates were closed and had been for some time prior thereto. At the time there was no engine in the defendant's building which required water power and the raceway structure was maintained merely as a dam to hold back the water from the pond. While some of the timbers of this structure showed signs of decay on their surface and while there were cracks between the planks which formed the face of the structure, repairs which had been made thereto in March, 1938, fortified the then existing condition and rendered the wooden portion in a reasonably safe condition to withstand the pressure of water against the pond side thereof on September 20, 1938.

As previously stated, this wooden structure was embedded in masonry abutments. These abutments were each about 12 feet square and about 30 feet high. One was located at the east and the other at the west side of the so-called raceway gates. That the easterly abutment was in a reasonably safe condition to withstand the pressure of water from the pond on September 20 and 21, 1938, is self-evident, as it completely withstood the flood in question. Across the top of the westerly abutment there was a crack extending downward for a distance of four feet into the masonry, but there was no satisfactory evidence that this crack in any way affected the strength of this abutment or of the raceway gate structure. Consequently it cannot be found that the westerly abutment was other than in a reasonably safe condition.

B-17

The westerly side of the aforesaid westerly abutment formed the northwest boundary of the defendant's land. To the west thereof the pond in question bordered upon land of one Flora B. Pendexter. To the north of and separating the Pendexter property from the pond there was an embankment composed of a double stone wall with earth between and on the top thereof there were stone slabs. This embankment was about two and one-half feet higher than the crest of the spillway portion of the dam and was of the same height as the raceway gate structures.

From all of the evidence offered upon the subject of the condition of the banks and structures at the southerly end of Hanover Pond it is found that they were in a reasonably safe condition to withstand any ordinary pressure of water which the pond contained or had contained prior to September 20, 1938, and consequently did not constitute a nuisance within the legal meaning of that term.

For six days prior to September 20, 1938, considerable rain had fallen, constituting in all a rainfall of eight and six-tenths inches. On September 20, 1938, an additional rainfall of six and one-tenth inches occurred. Such a rainfall was unprecedented during the history of Hanover Pond. The drainage into the pond covered an area of 95 square miles and the unprecedented rainfall caused the water in the pond to rise to a height above that which had ever before occurred. During the afternoon of September 20, 1938, the water rose in the pond to such an extent that it not only flowed over the spillway and platform of the blow-off gates before mentioned but also flowed over the embankment to the west of the so-called raceway gate structures. This flow of water increased as the hours passed and caused an erosion of the bank somewhere within an area of 60 feet to the west of the westerly abutment of the raceway gates. The water flowing over this bank swirled to the west, eroding property located to the north of the plaintiff's property and finally, at about 2 o'clock a.m. on September 21, 1938, eroded the embankment which contained the westerly abutment to the raceway gates to such an extent as to cause such abutment to give way and carry with it the aforementioned wooden structure which constituted the raceway gates themselves. When this occurred a great body of water was released from the pond, which water, swirling to the west, eroded the plaintiff's property and carried away a portion thereof, together with the building thereon.

From the foregoing, and all of the other facts and circumstances which the evidence disclosed, it is found that the destruction of the plaintiff's property was not proximately caused by the maintenance of a nuisance by the defendant, but was solely and proximately due to an act of God.

For the foregoing reasons judgment may enter for the defendant upon the issues of the complaint, and for the defendant to recover of the plaintiff its costs.

Copy sent Mayor Danaher 6/6/41 — 4 copies made 8/26/41
" " Mr. Blair 6/10/41 — 1 - Mr. Sengle
" " Mr. Cone 6/10/41 — 1 - Minutes folder - Dams
" " Mr. MacKenzie 6/10/41 — 1 -
" " Mr. Palmer 6/10/41 — 1 -

May 26, 1941

H A N O V E R D A M

FINDING OF FACTS

Prepared by R. W. S.

On March 24, 1941, Mr. Clarence M. Blair, a member of the State Board of Supervision of Dams, acting under the provisions of Section 1050e of the General Statutes, issued an order to the City of Meriden to remove or place in a safe condition Hanover Dam owned by it. Such order was based upon his finding that the dam was in an unsafe condition.

The City of Meriden, acting by its Mayor, the Honorable Francis R. Danaher, requested a hearing before such Board under the provisions of Section 1056e of the General Statutes. The hearing was held in the Meriden City Hall on April 30, 1941. Those present representing the Board were: Sanford H. Wadhams, Chairman, and Clarence M. Blair, Joseph W. Cone, William H. Cadwell, William A. MacKenzie and Shepard B. Palmer, Members. The City of Meriden was represented by Mayor Danaher and Mr. Prann, City Engineer. The hearing was also attended by a number of property owners from South Meriden. After the hearing the site of the dam was viewed by Board members and others.

The following facts were found from the testimony and records submitted.

Hanover Dam is located on the Quinnipiac River within the city limits of Meriden. The gross area of the watershed above the dam is 92 square miles, and the net area after allowing for diversions is 83 square miles. The maximum flood discharge in a watershed of comparable area, as indicated by tables used by the State Board of Supervision of Dams, prior to the hurricane and flood of September, 1938, was 169 cu. ft. per second per square mile. The characteristics of the Quinnipiac River watershed were such as to justify a lower estimated flood discharge. The center of the storm which produced the flood of September, 1938, is located at a distance of approximately 35 miles from the Quinnipiac River watershed. A gauging station maintained by the U. S. Geological Survey at Wallingford recorded a flow at that point of 48 c.f.s./s.m. or approximately 5,200 c.f.s. The area of the watershed above Wallingford measures 107 square miles.

B-19

In July, 1938, after an inspection of the dam by Messrs. Blair and Palmer, recommendations were made to the Connecticut Gas Products Co., the then owner of the dam, that the spillway be rebuilt and decayed timbers replaced. At that time the structure consisted of a spillway 171 feet long, gates on the east of

the spillway, and an embankment west of the spillway in which there were gates located a few hundred feet from the spillway leading to a canal or headrace 20 feet wide and 400 feet long, which formerly supplied the water for power developed at the plant occupied by the Connecticut Gas Products Co.

During the flood of September, 1938, the gates and headrace on the east side and the embankment between such headrace and the spillway failed. No serious damage resulted due to the fact that the washout was gradual. Thereafter the dam, which had formerly been the property of the City of Meriden, was reconveyed to the city by the Gas Products Co. Hanover Pond is part of a municipal recreational development, and a substantial sum has been expended thereon by the city.

On August 28, 1939, Mr. Prann, City Engineer, forwarded to Mr. Blair prints showing proposed construction to replace the old wooden bulkhead located west of the spillway as a "first step in a replacement and repair program." On August 30th Mr. Blair wrote to Mr. Prann recommending that repairs should be undertaken only under a comprehensive plan that would include all work to place the dam in a safe condition, and he refused a permit for the proposed bulkhead. At the same time Mr. Blair issued an order that such bulkhead or blowoff gates should not be closed until the structure was rebuilt under plans approved by the State Board of Supervision of Dams. Either prior to August 28th or immediately thereafter the washed-out section of the embankment was replaced by the City of Meriden without a permit for such repair.

As a result of the flood of 1938, the run-off estimates of various watersheds in this area were revised by the State Board of Supervision of Dams in order that spillways might be designed to provide for larger volumes of flood waters. Subsequently the city made application for the approval of repairs to the spillway as a W.P.A. project, and as preliminary to the issuance of such a permit a request was made that the State approve a proposal to repair the dam in accordance with the order issued to the Connecticut Gas Products Co. in July, 1938. Under the W.P.A. regulations it was also necessary for the city to secure an approval of its plans by the War Department. On November 23, 1939, during an inspection of the dam, Mr. Blair advised Mayor Danaher and Mr. Prann that he would issue a permit for the repair of the spillway in accordance with the order of July, 1938, if, in addition thereto, the crest of the spillway were lowered three feet. The U. S. District Engineer at Providence did not approve the project for the reconstruction of the Hanover Dam upon the basis of data submitted by the city, and on March 21, 1940, Mr. Blair wrote to the District Engineer furnishing such data and outlining the terms of the permit which the State had agreed to issue and the circumstances under which such an agreement had been made.

On April 23, 1940, the District Engineer advised Mr. Blair that on April 10th his office had advised the W.P.A. administrator for Connecticut that it had no objection to the reconstruction of the Hanover Dam provided that certain specified modifications were incorporated in the work. One of the requirements was that the spillway be lowered three feet from its existing elevation. Another was that the dike be raised by extending the side slopes upward a vertical distance of five feet. On May 14, 1940, Mr. Blair issued a preliminary certificate based upon plans submitted to him. On September 6, 1940, a slight revision of the plans was approved by Mr. Blair.

The spillway discharge of 18,000 c.f.s. as computed by the Army Engineers provided for a discharge of 217 c.f.s./s.m. The plan approved by Mr. Blair provided for a spillway discharge of 11,000 c.f.s. or 132 c.f.s./s.m. of watershed, and included a freeboard of five feet.

Col. Bragdon, the U. S. Army District Engineer, in commenting upon the spillway design approved by him, stated in a letter to Mr. Blair dated September 6, 1940, that the designed flood discharge of 18,000 c.f.s. permitted a surcharge of ten feet over the spillway, and that in addition there was available a freeboard of 2.5 feet above the surcharge. He added: "This freeboard is essential to prevent overtopping of the earth embankment section of the dam. Failure of this dam would cause widespread flood damages at several communities downstream from the dam site."

After work on the dam had been begun by the W.P.A., it was discontinued for reasons not pertinent to the present inquiry. On February 19, 1941, Mr. Blair made an inspection of the Hanover Dam and discovered that the work was being done under private contract in accordance with plans that would result in construction of the spillway at a level two feet higher than was indicated on the plans which he had approved on May 14, 1940. Computations of Mr. Blair indicated that the plan being followed by the city provided a spillway capacity of only 6,000 c.f.s. or 72 c.f.s./s.m. in comparison with the discharge capacities of 11,000 and 132 respectively as provided by the approved plan. On the following day he wrote to Mayor Danaher to ascertain whether this information as to the spillway level was correct. On February 25th Mr. Prann mailed to Mr. Blair prints of the revised plan for the reconstruction of the spillway. On the same date Mr. Blair wrote to Mayor Danaher reviewing the facts and giving a formal notice to cease any work that was in violation of the terms of the permit already issued. He likewise wrote to Mr. Prann on that date advising that the plan submitted by the latter marked "Revised August 20, 1940" was not approved.

B-21

On February 28th a conference was held in the office of Mayor Danaher at which Messrs. Blair and Palmer of the Board, Mayor Danaher and Mr. Prann of the city, and Messrs. Sengle and Wise of the State

Water Commission, were present. It was admitted that the city was making repairs to the dam under private contract in accordance with plans that were not approved by the State Board of Supervision of Dams, and that the work on the spillway would be completed that day. The meeting adjourned with the understanding that a check would be made to determine whether the capacity of the gates at the dam would be adequate if left open at all times except during the months of July and August to prevent danger from flood run-offs. On March 5, 1941, Mr. Blair advised Mayor Danaher by letter that his computations indicated that the total discharge of all sluice gates would not exceed 1,200 c.f.s., and that such a discharge capacity, even though it increased the discharge capacity of the spillway as reconstructed by the city to a total of 7,200 c.f.s., was inadequate to avoid flood dangers. In Mr. Blair's opinion the dam as reconstructed by the City of Meriden was unsafe,and on March 24, 1941, he issued the order referred to above, ordering the City of Meriden to place Hanover Dam in a safe condition or to remove the same.

80-1-1

S. H. Wadhams
June 19, 1941

MEMORANDUM

Subject: Hanover Dam
Meeting of Board of Supervision of Dams

Present: All of the members of the Board and Mr. Sengle of the State Water Commission.

On June 18 at 11:30 a.m., the Board met at the Hanover Dam to consider what action should be taken in reference to the questions which have been raised by Mayor Danaher. The facts in this case have been summarized in a "Finding of Facts" and therefore will not be repeated here.

The Board found the dam was full and the water was running over the spillway, this in spite of the fact that Mr. Blair had given permission to fill the dam only within three feet of the top of the spillway.

The Board also found a considerable stream of water which apparently was coming out underneath the new embankment. A long-time resident of the vicinity advised the members of the Board that for many years there had been a spring in this locality. It seems very improbable, however, that a spring exists there which produces any such volume of water as was escaping at the time of the inspection. The Board noted, too, that on the upstream side of the embankment there had been some slipping or settling.

Following this inspection of the dam, the members of the Board went to Wallingford, where the whole question was reviewed at considerable length. As to Mayor Danaher's contention that the Board has no authority over the repairs which have been made, it was the consensus that that could be dismissed as unfounded. The Board is unanimously of the opinion that the dam is not now a safe structure, first, because of inadequate spillway capacity and, second, because of improper construction of the repaired embankment.

Mr. Palmer suggested that sheet steel piling be driven down to the solid earth underneath the new embankment and that the embankment itself be raised sufficiently to provide the necessary spillway capacity.

B-23

The Board was of the opinion that the leak referred to above should be very carefully investigated to determine

whether or not this water is coming through and underneath the embankment. It was agreed that a weir should be put in to determine possible fluctuation in volume of flow under varying conditions of water level in the dam. The question of how this could be done was discussed at considerable length, and the Chairman stated that he would see if the State Water Commission had funds which could be used for this purpose.

The Board was of the opinion that the remedy to be preferred is to lower the spillway by two feet, but recognizing that that step would be quite expensive and would also largely destroy the recreational value of the pond, the Board would accept the raising of the embankment and the putting in of a sheet steel cut-off. It was suggested by Mr. Blair that some wellpoints might be driven down at selected places on the embankment to secure information as to the ground water table and the effect of this water level on various heights of water in the dam. The suggested weir, with such wellpoints, would give very valuable information.

There was considerable general discussion as to how the estimated capacity of the spillway of 11,000 c.f.s. could be justified. Mr. Sengle pointed out that it would be most desirable to tie our figures in with some official publication on flood discharges.

It was decided that a letter should be written to Mayor Danaher, advising him of the Board's findings regarding the safety of the dam and that the Board concurred with Mr. Blair in his estimate of the required spillway capacity. Also he should be advised that the Board finds the estimate of unit run-off used by Mr. Blair as reasonable for a watershed having the characteristics of the one under consideration. The Board's recommendation would be that the preferred remedy of the present situation would be to lower the spillway, but as an alternative it would accept raising of the embankment with a sheet steel cut-off, all to be done under plans prepared by the City Engineer of Meriden and approved by the Board of Supervision of Dams.

The Mayor should further be advised that, since filling of the reservoir, a considerable stream of water has appeared at the lower surface of the newly constructed embankment, and it is important that, before deciding on the exact steps to be taken to make the dam safe, further investigations must be made. These investigations would consist of the construction of a weir to measure the flow of this water and a series of wellpoints through a section of the embankment. After this has been done, the Board will be in a better position to arrive at a definite conclusion.

B-24

S. H. Wadhams, Chairman

SHW G

80-1-1

(DRAFT)

July 11, 1941

Hon. Francis R. Danaher
Mayor, City of Meriden
Meriden, Connecticut

Dear Mayor Danaher:

The Board of Supervision of Dams has given most careful thought and study to the question you have presented to it regarding Hanover Dam. With your assistance, a weir was installed below the newly constructed embankment, and pipes were driven into the embankment. The information obtained seems to indicate beyond any reasonable doubt that the embankment is not impervious to water.

When the weir was installed and the level of water in the dam was at the crest of the spillway, the flow below the dam measured approximately 300,000 gallons per day. When the dam was emptied, this flow rapidly dropped until on July 3 it measured slightly in excess of 60,000 gallons per day. This flow has steadily decreased in volume until at the present time the rate of flow is less than 5,000 gallons per day.

The observations made in the pipes driven into the embankment supported the conclusion that the water was escaping through the embankment. The appearance of sand boils below the embankment was further indication of leakage.

Under these circumstances, the Board arrived at the following conclusions:

1. A tight corewall of steel sheet piling should be provided for the new embankment. This should be driven into the original ground surface to refusal or at least 10 feet into the ground below the embankment and to extend 4 feet above the top of the present embankment.

2. Raise the embankment to a level of about 12 inches above the sheet piling.

3. Slope pave the upstream face of the embankment from at least 12 inches below spillway level to the top of the sheet piling and extend around the westerly end of the embankment.

4. Raise the corewall in the old embankment westerly of the spillway from the present spillway level to the height of the steel sheet piling referred to in (1). It would be desirable to make certain that there is now a corewall in this old embankment. The old embankment would, of course, require raising to the same height as the new embankment - that is, one foot above the steel sheet piling.

B-25

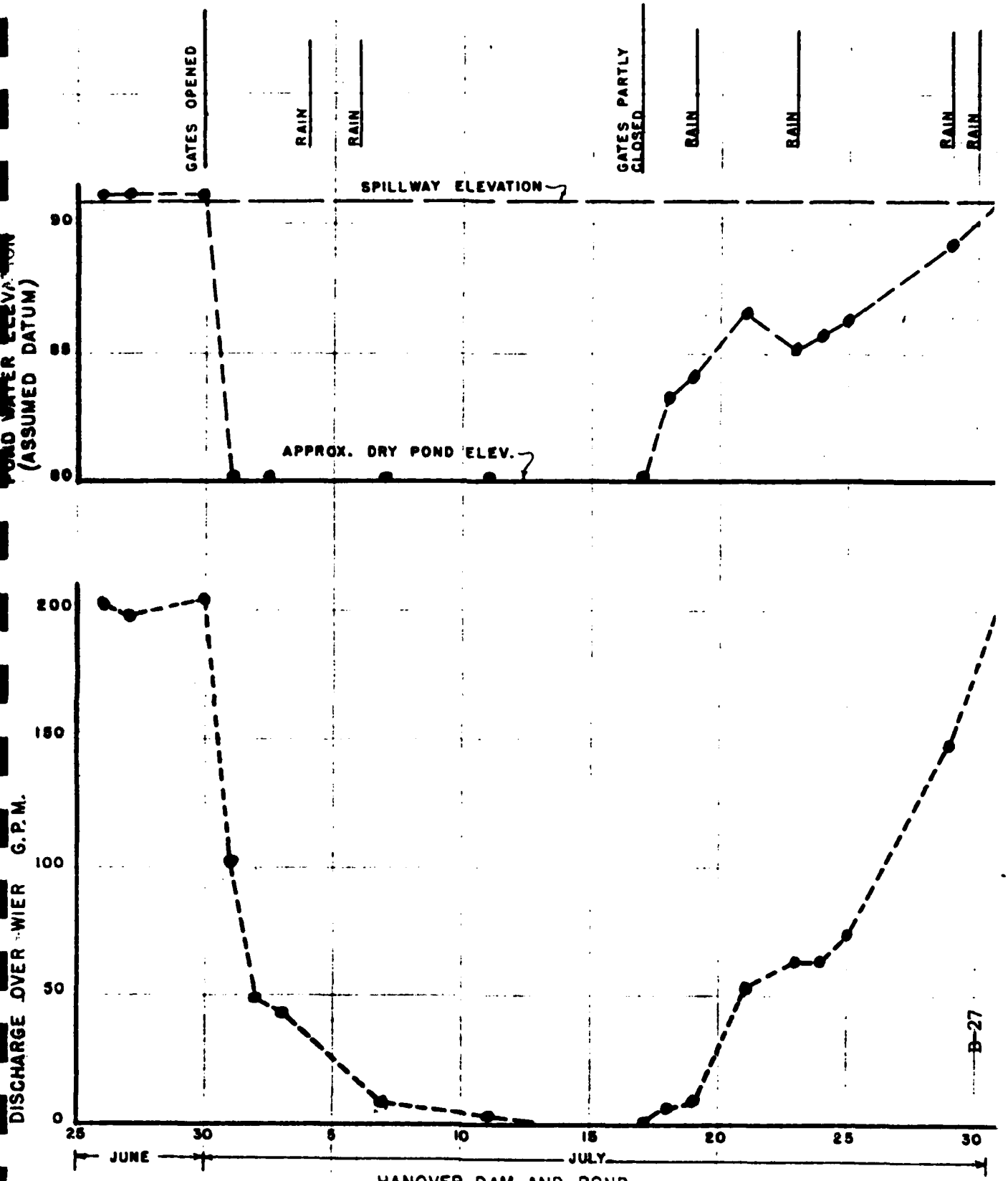
5. Slope paving should be provided on the upstream face of the embankment from at least 12 inches below spillway level to the top of the corewall and the paving extended around the easterly end of the embankment to form a masonry slope above the present spillway.

In conclusion, the Board wishes to recommend that plans be prepared by an engineer familiar with this type of construction and that such plans be submitted to the Board before construction work is begun. We wish to assure you that we will be only too glad to cooperate with you and your engineer in carrying out this work.

Very truly yours,

S. H. Wadhams, Chairman

CHW G L



HANOVER DAM AND POND

SOUTH MERIDEN, CONN.

EFFECT OF POND WATER ELEVATION ON SEEPAGE BELOW DAM

NEW READINGS & POND WATER ELEVATIONS

STATE BOARD OF SUPERVISION OF DAMS JULY 31, 1941

mailed to S.M.D. Ward 9/24/42
9/24/42
14.
80-1-1

6. Summary of Findings and Conclusions

Following is a brief summary of my findings and conclusions as to the safety of the Hanover Dam at Meriden, Connecticut concerning which I have been requested to submit my opinion:

(1) The probable maximum peak flow to be expected in the Quinnipiac River is at least 10,000 cubic feet per second, which is equivalent to about 105 cubic feet per second per square mile, based upon the total drainage area of 95 square miles of which some 12 square miles is diverted or partially diverted when stream flows are normal.

(2) The existing spillway capacity of the dam is about 3,000 cubic feet per second when the water level is at elevation 95.0, 3.5 feet above the crest of the spillway. At this elevation the four sluice gates through the east spillway abutment provide additional capacity of 1,000 cubic feet per second, but all of this additional capacity cannot be safely relied upon for flood protection purposes, as the trash racks probably would be covered with debris at times of heavy storms.

(3) Records of weir tests and embankment seepage tests of the portion of embankment constructed by the City in 1939 to repair the damage caused by the "hurricane storm" of September 1938 show considerable leakage and a relatively high line of saturation when the water is at spillway level. In my opinion these records indicate that this section of the embankment would not be safe if the flow line exceeded 3.5 feet above the spillway level.

(4) When the flow line is 3.5 feet above spillway level there is only 2.5 feet of freeboard between the water surface and the top of the embankment, as compared to 3.5 feet which I consider a safe margin.

(5) For the above reasons, I believe the dam including the earth embankment is not safe when the water surface exceeds elevation 95.0 and the discharge over the spillway is about 3,000 cubic feet per second.

(6) The spillway would have a capacity of 6,000 cubic feet per second if the water surface were 5 feet above its crest and the gates would have a capacity of 1,050 cubic feet per second. I believe the embankment would fail if the water reached this elevation for the reasons stated above.

(7) Suggested methods of providing safely for estimated peak flood flows are lowering the spillway and raising the embankment; and keeping the spillway at its present elevation, raising the

embankment and providing additional spillway capacity at the west end of the present embankment to take care of excess flows during extreme floods.

(8) A failure or break in the dam would damage public and private property below the dam.

(9) It is my opinion that the dam is not safe to take care of flood flows which reasonably can be expected in the future; that an engineer experienced in this type of work should be authorized by the City to make a detailed investigation and to prepare plans and specifications for changes necessary to make both the spillway and embankment safe; and that such plans and specifications should be submitted to the Board of Supervision of Dams for approval as soon as practicable.

Respectfully submitted,

(signed) Malcolm Pirnie

MP/jd

Dec. 30, 1941
Revised March 2, 1945

HANOVER DAM, MERIDEN

1938 Under date of May 26, 1938, Mr. Clarence M. Blair, member of the State Board of Civil Engineers, received an application in writing from the State Highway Commissioner in which the stability of this dam was questioned and calling Mr. Blair's attention to the fact that, should the dam fail, damage would be done to the highway bridge over the Quinnipiac River a short distance south of the dam.

Acting under Section 3058, C.S., 1918, Mr. Blair visited the dam on June 2, 1938.

Mr. Blair and Mr. Palmer made an inspection on July 12, 1938, at which time the reservoir was practically empty.

On July 16, 1938, Mr. Blair served formal notice on the Connecticut Gas Products, Inc., to place this dam in a safe condition. With this formal notice, he extended several recommendations and advised that plans for repairs were to be submitted for his approval.

In the flood of September, 1938, the Hanover dam went out. (Sept. 21)

1939 On Aug. 28, 1939, following a conference with Mr. Blair at the Hanover dam, Mr. Prann forwarded to Mr. Blair two prints showing proposed construction intended to replace the old wooden bulkhead located west of the main dam spillway which was carried away by the flood of Sept. 21, 1938. This proposed plan was submitted to Mr. Blair for his approval.

On Aug. 30th Mr. Blair wrote to Mr. Prann, calling his attention to the formal notice of July 16, 1938, to the Connecticut Gas Products, Inc., mentioned above, and advising Mr. Prann that the orderly way to approach this problem was to set up on his plans all the work necessary to be done to place the dam in a safe condition. Mr. Blair could not approve any filling of this pond until the spillway repairs were made.

On Oct. 30, 1939, Mr. Blair wrote Mr. Prann regarding an investigation he had made on Oct. 27th, to ascertain the status of this structur He was surprised to find that work had been done without any permit fro a member of the Board of Supervision of Dams and in violation of the act. In view therefore of Mr. Prann's knowledge of the order to the Conn. Gas Products, Inc., dated July 16, 1938, and Mr. Blair's letter of Aug. 30, 1939, Mr. Blair could see no justification for Mr. Prann's proceeding with this work. Mr. Blair therefore issued a formal notice prohibiting Mr. Prann from closing the waste gates in the dam until the structure was rebuilt under plans approved by the State Board of Supervision of Dams.

On Oct. 31st, in reply to Mr. Blair's letter to Mr. Prann, Mayor Danaher advised Mr. Blair that Meriden was in no position to build another spillway at the site of the dam and did not intend to do so.

B-30

On Nov. 1st Mayor Danaher advised S.H.W., chairman of the State Board of Supervision of Dams, that the city was prepared to go ahead with work on the dam as recommended by Mr. Blair on July 16, 1938 to the Conn. Gas Products, Inc. As the WPA would do the work, they would

require a certificate of approval from Gen. Wadhams' office before starting.

In reply to Mayor Danaher on Nov. 3rd, Gen. Wadhams pointed out that the usual procedure was to have the owner of a dam submit the plans of the work to be done to the Board, that the Board's concern was with the safety of the structure, and, if the plans submitted indicated that this requirement had been met, authority to proceed with the work was given at once, and, upon its completion, a certificate furnished to the owner.

On Nov. 3rd, in reply to Mayor Danaher's letter of Oct. 31st, Mr. Blair pointed out that he must insist on the enforcement of the formal notice given to Mr. Frann in his letter of Oct. 30th that the City of Meriden be prohibited from closing the waste gates until the dam is rebuilt. He added that of course the mayor had the right of appeal under Section 1056e.

On Nov. 6, 1939, Gen. Wadhams wrote to Mr. Blair describing a talk he had had at the Hanover dam with Mayor Danaher on Nov. 15th. It appeared that the mayor was awaiting approval of a WPA project for doing the work, but that the WPA required the approval of both the State and the Army Engineers. Following this, a conference was held at the dam site (Nov. 23rd).

1940 On March 15, 1940, Mr. Blair, in acknowledging a letter of March 10th from Mayor Danaher in which he asked Mr. Blair to be "lenient" in the matter of the Hanover dam, wrote as follows:

> "As matters now stand, I want to renew my offer of cooperation. However, we are not in agreement on several fundamental matters in connection with Hanover Dam. I cannot yield on these matters when all my engineering knowledge and training indicates that the facts are clearly defined, and I would be guilty of violating my commission if I did not insist on the dam being constructed in accordance with the Statutes.
>
> "I have certain ideas of what might be done with Hanover Dam that might bring it up to my requirements, but any change would mean additional expense to you. I would not care to discuss these matters except with the entire Board of Supervision of Dams.
>
> "If your engineer has any proposals to make regarding the reconstruction of this dam to allow for ample spillway capacity, I will be pleased to receive them. I think he must first, however, convince himself that the Statutes clearly apply to this dam."

B-31

On March 21st Mr. Blair forwarded certain data to Col. Bragdon and his reasons for his decision to issue a permit authorizing construction. Mr. Blair felt that he had given Col. Bragdon sufficient data to permit him to reconsider the Hanover dam project, pointing out that it was extremely desirable for all parties concerned that this dam be reconstructed.

On April 25th Mr. Blair wrote Gen. Wadhams regarding a talk he had had with Mr. Prann who had advised him that Col. Brandon agreed with the findings of the State Board of Supervision of Dams with only a few additional comments. The situation therefore was at this time that the City of Meriden would make application to the WPA administrator for Connecticut for a permit to proceed and that the plans would be submitted to Mr. Blair for approval.

On May 14th Mr. Blair forwarded to Mr. Prann Preliminary Certificate No. 30-20 permitting construction of repairs to the dam as per plans submitted to him. Attention was called to the instructions contained in the Board of Supervision of Dams booklet.

1941 On Feb. 20, 1941, Mr. Blair advised Mayor Danaher that following the issuance of a permit under date of May 14, 1940, he had inspected the work being done on Feb. 19th. At that time he had learned that the contractor was planning to raise the proposed spillway level two feet higher than that shown on the approved plans.

Mayor Danaher replied to this letter on Feb. 21st;

> "I have received your letter of February 20th concerning the above matter. I respectfully recall to your attention a meeting between you, General Wadhams, Mr. Prann and, I think, Mr. Copeland and me on the sight of the Hanover Dam some year and a half ago. At that time we discussed the Dam situation thoroughly. You will recall that I raised serious objection to lowering the Dam three feet in accordance with the desires of the Army engineers because it would leave the greater part of the pond bed out of water and would so lower the water at Red Bridge that we could not use it for swimming. At that time you indicated that three feet was a drastic reduction and I inquired whether you would agree on a one foot reduction. You indicated to me that a one foot reduction at the lip of the Dam would be satisfactory to the State but it proved to be unsatisfactory to the Army engineers. We discussed at the same time the placing of flash boards across the top of the Dam to raise the water to the required height for swimming in the event that the Army engineers insisted on a three foot reduction."

On Feb. 26th Mr. Blair advised Gen. Wadhams by telephone of his efforts to have the Hanover dam built according to the plans which he had approved. He stated that he had issued formal notice to the Mayor of Meriden, Feb. 25th, that work must be stopped at once. Mr. Blair suggested that early action should be taken and that the mayor should exercise his right to have the plans passed upon by the full Board. There was also received from Mr. Blair this date the complete file of the letters which had passed between the Mayor and Mr. Blair. B-32

On Feb. 27th Mr. Blair advised Mr. Prann that his plan as submitted is <u>not</u> approved on account of inadequacy of spillway dimensions.

On Feb. 28th a conference was held in Mayor Danaher's office with the Mayor, Mr. Blair and Mr. Palmer of the State Board, Mr. Prann, Mr.

Wise and Mr. Sengle. It was decided at this meeting that the matter should be passed on by the full Board and that Mayor Danaher and Mr. Prann be invited to accompany the engineers during the inspection of the dam.

On March 3rd Mr. Blair asked the chairman of the Board whether a formal notice should be served on the mayor that the dam is a menace to life and property.

Mr. Sengle replied to Mr. Blair on March 4th, suggesting that Mr. Blair advise the mayor that he was giving consideration to the preparation of an order under the provisions of Section 1050e directing the city to place the dam in a safe condition or to remove it, but that he (Mr. Blair) was hopeful that such action would not prove necessary.

Mr. Blair wrote Mayor Danaher on March 5th: "You have now completed the spillway in accordance with your plans which I have not approved and in spite of my order dated Feb. 25, 1941 - 'to cease any part of the work that is in violation of the permit issued.' " Mr. Blair also forwarded to Mayor Danaher correspondence with Col. J. S. Bragdon, U. S. Army Engineers, in regard to the dam design.

In reply to Mr. Blair's letter of March 5th, on March 10th Mayor Danaher expressed the hope that Mr. Blair would be lenient and that the conclusion of his consideration of all the matters involved would not order any change in the existing dam. Mayor Danaher added that he did not feel there was any danger of loss of life and little or no loss of property, should the Hanover dam or its abutments fail.

On March 17th Mr. Sengle advised Mr. Blair by letter that Mayor Danaher had written to the Attorney General to say that he wished an opportunity to be heard before any action was taken by the State. Mr. Sengle had talked with Judge Pallotti this date and suggested that his office might be left out of the matter for the time being, if Mr. Blair were to issue an order under the provisions of Section 1050e and the City of Meriden were to file a written request for a hearing before the full Board. Mayor Danaher was called on the telephone and it was Mr. Sengle's understanding that this procedure would be followed.

On March 21st Mayor Danaher requested a hearing before the full Board.

On March 24th Mr. Blair issued his order to Meriden: "I order you to place Hanover dam in a safe condition or to remove it and fix the time as eight weeks from the date hereof within which this order shall be carried out."

B-33

On March 27th Mayor Danaher advised Mr. Blair that he had made application for a hearing before the full Board. Because of delay due to Mr. Sengle's illness and Mr. Blair's absence from the State, the hearing before the Board was not held until April 30th.

Mayor Danaher had suggested that the time limit fixed in Mr. Blair's order be correspondingly extended.

A "Finding of Facts" to date of March 24th was prepared in this office on May 26th. Copies were forwarded to Mayor Danaher and all members of the Board.

Mayor Danaher acknowledged this statement on June 7th. He noted that no mention was made of the most serious objection raised by him, namely, that the repairs made to the Hanover dam did not substantially affect the stability of the dam. Mayor Danaher expressed himself as anxious for a determination of this matter.

On June 14th Gen. Wadhams advised Mayor Danaher that the Board would meet on June 18th to further consider this matter. He referred in his letter to the State's unfortunate experience at the Bolton Dam.

All members of the Board were present with Mr. Bengle at the meeting in Wallingford on June 18th. It was decided that a letter should be written to Mayor Danaher advising him of the Board's findings regarding the safety of the dam and that the Board concurred with Mr. Blair in his estimate of the required spillway capacity.

On June 20, 1941, Gen. Wadhams advised Mayor Danaher of the result of the meeting of June 18th, namely, that the Board concurred in Mr. Blair's finding that the dam in its present condition is unsafe and should be repaired or removed, and requesting Mayor Danaher's views on the above matters.

On June 21st Mayor Danaher acknowledged this letter and stated that the city agreed to raise the embankment and strengthen it and also that the city would stand the expense of building the weir for making the tests suggested by the Board.

(Engineers from the State Water Commission took flow measurements at the embankment for several weeks.)

On June 30th Mr. Prann, city engineer, in reply to our letter of June 20th regarding the flow of water below the earth embankment, trusted that the results of our examinations would show the structure to be stable.

On July 5th Mr. Blair forwarded to Gen. Wadhams his discussion of the Hanover dam and the future steps to be taken. Mr. Blair's suggestions were forwarded to all members of the Board for their consideration. All members of the Board, with the exception of Mr. Clarke, commented.

On July 11th, following receipt of the above material, Gen. Wadhams drafted a letter for Mayor Danaher regarding the employment of a competent engineer and the steps to be taken to ensure a safe structure. This letter was submitted to all members, was fully commented on and revised as per suggestions from members and sent to Mayor Danaher on July 16th.

B-34

No reply having been received, a further letter was written to the mayor on Aug. 25th.

On Sept. 5th Mayor Danaher acknowledged the letter of July 16th. He stated that he considered the Board's suggestions quite stringent

and wished to know whether further tests of the flow of water below the embankment could be carried on.

On Oct. 3rd, Gen. Wadhams referred Mayor Lanaher to the Board's letter of July 16th in which the Board wrote: "The conclusion is inescapable that the embankment is not watertight," and enclosed figures. Mayor Lanaher's decision was requested.

On Dec. 4th, following the mayoralty election, Mayor Lanaher was again written to.

On Dec. 10th Mayor Lanaher replied that he was satisfied that no danger existed at the Hanover dam and he was not inclined to follow the suggestion concerning steel sheathing (July 16th letter).

A meeting of the Board was called for Dec. 22nd. This meeting was held in Wallingford.

Board's conclusions - see order to City of Meriden dated January 5, 1942.

March 15, 1945

January 2, 1942 - Draft of order to city sent to Pallotti and to each member of Board. Approved by Pallotti, Blair, Clarke and Cone.

January 5, 1942 - Order sent to city. This order recounted the history of the case. Question of stability of dam first raised by State Highway Commissioner on May 26, 1938, in letter to Board of Civil Engineers.

Dam was inspected and found unsafe. Conn. Gas Products Company so advised July 16, 1938.

Dam washed out in flood of September 1938.

On August 28, 1939, city submitted to Mr. Blair blueprints for proposed repair work. Mr. Blair asked certain changes in the interest of increased stability. City did not reply to Mr. Blair

In October 1940 Mr. Blair found reconstruction work was underway despite the fact that the city had not complied with the law by first getting a permit.

After much correspondence and numerous conferences in an effort to persuade the city to rebuild the dam so as to make a safe structure, Mr. Blair on March 24, 1941, issued a written order to the city to either place the dam in a safe condition or to remove it within a period of eight weeks.

B-35

The city appealed the order to the full board. A hearing was held on April 30, 1941. On July 16, 1941, the board advised the city by letter that certain changes in the dam must be made. On October 3, 1941, the board reiterated its recommendations for changes.

On December 10, 1941, the city advised the board it was not inclined to follow those recommendations.

The order directed the city to place the dam in a safe condition or remove it on or before June 1, 1942; that the city get its plans for the repair work approved by the board before starting work; and that the city, until completion of repairs, keep all gates fully open and the gate openings free of debris.

January 20, 1942 City denies the board has any jurisdiction.

January 30, 1942 City appeals from order.

March 31, 1942 City amends appeal, claiming order arbitrary, unreasonable and illegal.

May 27, 1942 Mr. Brooks reported that city was willing to have the board submit the names of engineers, to select one of them to make a survey of the dam, and to accept the opinion of the expert.

June 22, 1942 City notified Mr. Brooks it had selected Pirnie.

July 11, 1942 Resume of date and correspondence on case filed by Blair.

July 16, 1942 Stipulation mailed to city by Mr. Brooks, to be signed by State and City for Pirnie.

August 8, 1942 Stipulation received back from City, signed. Copy to Board, Pirnie, City and Mr. Brooks.

September 4, 1942. Brooks inquires from Danaher as to meaning of covering letter with stipulation. Brooks says "I propose to stand by my assurances and have no doubt that you will do the same. If you feel that any further comment is necessary, would you kindly advise me?

September 24, 1942 Pirnie's report received. Substantiates Board.

October 30, 1942 Letter from city "we are considering ways and means".

December 30, 1942 SHW letter to City suggesting conference.

February 8, 1943 SHW to Brooks, no reply from Danaher.

March 23, 1943 SHW to Brooks, no reply from Danaher.

March 24, 1943 Brooks to Mayor asking for statement of intentions.

April 8, 1943 Danaher to Brooks. "Mr. Prann and I are giving very serious consideration to the method of how best to meet the suggestions of Mr. Pirnie. When we have arrived at a decision, which should be in the near future, we will submit the proposals to you and to Mr. Wadhams and trust we will obtain your approval. If this is satisfactory, you will hear from us again in the near future." B-33

April 22, 1943 SHW to Danaher-recommend city employ engineer experienced in the construction of dams.

R. Martin, Deputy

CLARENCE BLAIR ASSOCIATES, INC.

Civil Engineers

P. O. BOX 236 SPRUCE 7-7378

93 WHITNEY AVENUE — NEW HAVEN, CONN.

WATER SUPPLY
SEWAGE DISPOSAL
WASTE DISPOSAL
SURVEYS
LAND DEVELOPMENT

...R C. BROWN
AMES C. BEACH
RANK RAGAINI

CHARLES E. AUGUR, JR.
ORDON BI IDES
OHN M. BREST
ONALD L. DISPROW
NICHOLAS PIPERAS, JR.

July 27, 1962

Mr. William S. Wise, Director
Water Resources Commission
650 Main Street
Hartford 15, Connecticut

Re: Hanover Pond Dam
Meriden, Connecticut

Dear Mr. Wise:

On May 29, 1962 I received plans for proposed construction at Hanover Pond Dam together with a letter from Mr. Dell asking me to take whatever action was necessary for the issuance of a construction permit. The plans covered proposed construction for repairs of the damage done to the spillway on or about March 14, 1962.

I visited the dam with Mr. Pfeiler, City Engineer of Meriden, on June 7 and on June 11 I discussed the dam with Mr. Curry, Chief Engineer of the Water Resources Commission, in his office. At that time Mr. Curry said that since this dam had been the subject of so much controversy in the past he wished to review the safety of the dam as a whole rather than consider only the adequacy of the plans presented for repair of the spillway.

The controversy between the State Board of Supervision of Dams and the City of Meriden in respect to Hanover Dam covered a period of several years beginning with the hurricane flood of September, 1938 and was in large part concerned with the proper peak discharge to be used in the design of the spillway.

B-37

Mr. William S. Wise, Director
Water Resources Commission July 27, 1962

In 1942 the Board retained Malcolm Pirnie, Consulting Engineer of New York City, to investigate and report on the safety of the dam. In his report he stated as follows:

"(1) The probable maximum peak flow to be expected in the Quinnipiac River is at least 10,000 cubic feet per second, which is equivalent to about 105 cubic feet per second per square mile, based upon the total drainage area of 95 square miles of which some 12 square miles is diverted or partially diverted when stream flows are normal.

(2) The existing spillway capacity of the dam is about 3,000 cubic feet per second when the water level is at elevation 95.0, 3.5 feet above the crest of the spillway. At this elevation the four sluice gates through the east spillway abutment provide additional capacity of 1,000 cubic feet per second, but all of this additional capacity cannot be safely relied upon for flood protection purposes, as the trash racks probably would be covered with debris at times of heavy storms."

In 1947, Mr. Linwood G. Mort, member of the State Board of Supervision of Dams, inspected the dam and reported:

" I find that the spillway gates and embankment on the east side are substantially the same as they were in 1942 and that no action has been taken to increase the spillway capacity. The capacity of the present spillway must be considered as not safe for a discharge of more than 3,000 C.F.S., and the gates offer a maximum discharge capacity of not over 1,000 C.F.S. The minimum discharge capacity that should be provided is 10,000 C.F.S."

Mr. William S. Wise, Director
Water Resources Commission July 27, 1962

In 1949 Mr. Curry, in commenting on a letter from the Meriden City Engineer attempting to justify a lower peak discharge, made the following statements:

"There is no reason for us to accept a lower design flow than the 10,000 c.f.s. recommended by Pirnie." and

"Since we cannot go along with any of these reasons for not designing for 10,000 c.f.s. we should not change our position on design flow".

Plans were submitted in 1950 for an additional spillway 80 feet long and 0.5 feet higher at the crest than the old spillway with the earth embankment to be raised to a height of 8 feet above the crest of the new spillway. I assume that the design of this additional spillway was based on a design discharge of 10,000 c.f.s. since my calculations show that the combination of the old spillway and additional spillway would pass 10,000 c.f.s. with a pond water surface 5.1 feet above the crest of the additional spillway.

An additional discharge of about 1,000 c.f.s. might be possible through the sluice gates providing that it was possible to get them open in time and that they were not clogged with debris.

B-39

A preliminary permit for construction for the additional spillway was issued by the Water Resources Commission on June 28, 1950. The spillway was built and was inspected at least once after completion but

there is no record in the file of a final certificate of approval having been issued.

On March 14, 1962 a portion of the reinforced concrete surface of the additional spillway collapsed and a considerable yardage of the underlying embankment material was washed away. The plans received on May 29, 1962 cover the rebuilding of the additional spillway to the same height and length as it was before the collapse. We will discuss the details of these plans later in this report.

We have said previously in this report that a discharge of 10,000 c.f.s. would pass over the combined spillways with a pond level 5.1 feet above the crest of the additional spillway. In terms of elevations shown on the plans this pond level would be at elevation 97.0.

The 1950 plans for the additional spillway show the top of dike raised to elevation 99.9. If this had been done the freeboard at design discharge would have been 2.9 feet.

I requested Mr. Pfeiler to furnish me with a profile of the top of the embankment as it is at present. This profile, received on July 19, 1962, shows that at no place is the embankment up to elevation 99.9 and at one point is at elevation 96.5 or 3.4 feet below the level called for on the plans. The pond level at design discharge would top the embankment for a longitudinal distance of about 110 feet.

Mr. William S. Wise, Director
Water Resources Commission July 27, 1962

One of the conditions of approval of plans for any construction on this dam should be the satisfactory raising of the embankment to the height shown on the 1950 plans.

It is my opinion, based on my investigation, that the design discharge for the combined spillways on this dam should be at least 10,000 c.f.s. consistant with Mr. Pirnie's recommendations and subsequent statements by Mr. Mort and Mr. Curry, and that the possible additional discharge capacity through the sluice gates be considered only as a safety factor because of the uncertainty of their operation and their efficiency.

The combined spillways, after the repairs to the additional spillway contemplated in the plans of May, 1962, will have a safe capacity of 10,000 c.f.s. provided that the embankment is raised to elevation 99.9 for its entire length.

There are some details of the 1962 plans which I have discussed with Mr. Pfeiler and he is making some changes in the plans, including additional length of steel sheet piling in the downstream line of piling and substitution of rock fill instead of clay fill in the space under the inclined splash apron.

B-41

Mr. William S. Wise, Director
Water Resources Commission

July 27, 1962

As soon as these changes are made, which should be not later than today, Mr. Pfeiler will send you revised plans. If these revised plans are satisfactory, I will recommend issuance of the Construction Permit for the spillway rebuilding, subject to the embankment being raised to elevation 99.9 for its entire length and for a satisfactory width.

Very truly yours,

Roger C Brown

Roger C. Brown

CLARENCE BLAIR ASSOCIATES, INC.

RCB:mmm

B-42

FORM PUR STO 201

INTERDEPARTMENT MAIL

DATE: April 25, 1968

TO: FILE — DEPARTMENT:

FROM: William P. Sander, Engineer-Geo. — DEPARTMENT: W. R. C.

SUBJECT: HANOVER POND DAM - MERIDEN

On the above date, an inspection was made of the subject dam. At about 9:15 A. M., Mr. Pelletier of this office received a telephone call from Mr. Marks of the City of Meriden Public Works Department stating that a failure had occurred at the dam which caused some damage downstream. IN THE EARLY MORNING

The undersigned arrived at the dam at about 10:30 A. M. A breach approximately 75 feet wide had eroded through the westerly dike and the pond was almost completely drained. The site of the breach was in the area where the De Fonce Construction Corporation of Bridgeport had indicated that they would construct a diversion to lower the pond while installing new sluice gates. Rainfall the previous night was probably in excess of two inches in the area and it was reported that the pond had been partially drained.

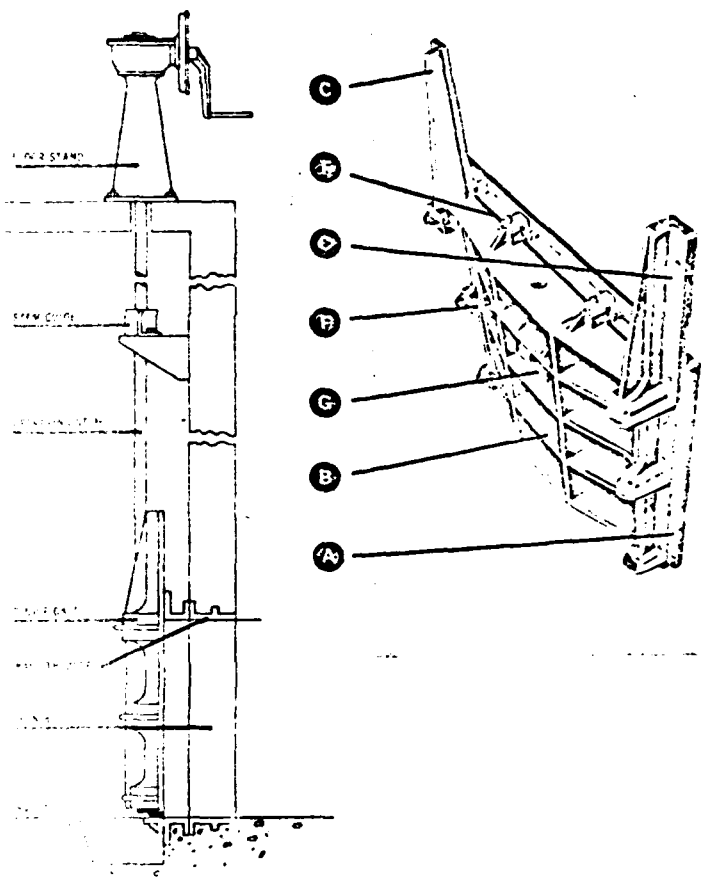
Observed downstream damage was relatively minor. The National Cylinder Gas Co. immediately below the dam had water in its ground floor. There was no apparent damage to the Route 70 bridge immediately below the dam nor to the other bridges downstream. There was no other observed damage.

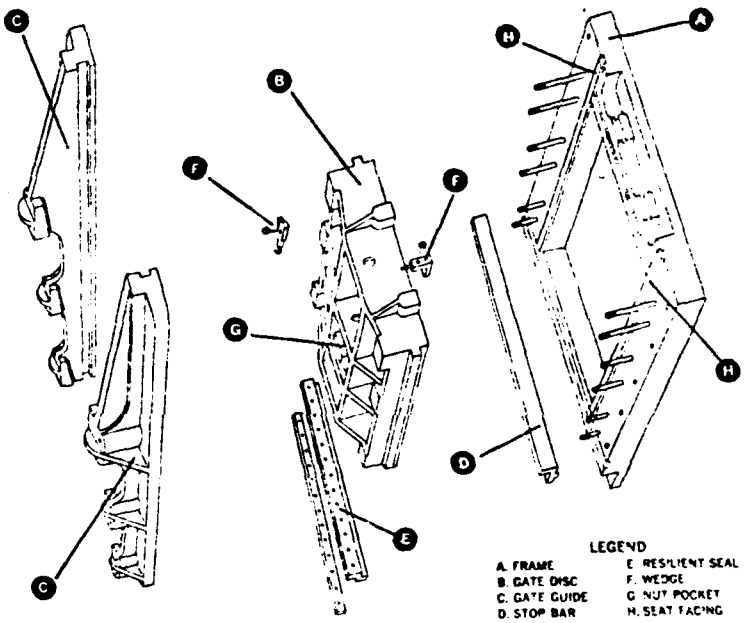
WPS

William P. Sander
Engineer-Geologist

B-43

Nomenclature





A typical installation of a HY-Q® sluice gate with flush-bottom closure is shown in the diagram at the left. The other illustrations show how a Rodney Hunt sluice gate is assembled and disassembled with parts keyed to a legend for identification.

Conventional Rodney Hunt sluice gates are essentially the same design, but without the resilient seal and stop bar.

Both types of gates are available as self-contained units with yokes and non-rising stems. Large or special gates are often shipped partially disassembled. Match markings should be carefully noted when gate assembly is made.

APPENDIX

SECTION C: DETAIL PHOTOGRAPHS

PHOTO NO.1 - Upstream side of dike and right spillway abutment. Note erosion upstream of abutment.

PHOTO NO.2 - Right spillway abutment wall and dike with trees growing next to wall.

US ARMY ENGINEER DIV. NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MASS.	NATIONAL PROGRAM OF	Hanover Pond Dam Quinnipiac River Meriden, Connecticut
CAHN ENGINEERS INC. WALLINGFORD, CONN. ARCHITECT—— ENGINEER	INSPECTION OF NON-FED. DAMS	CE# 27 595 DATE Feb 1979 PAGE C-1

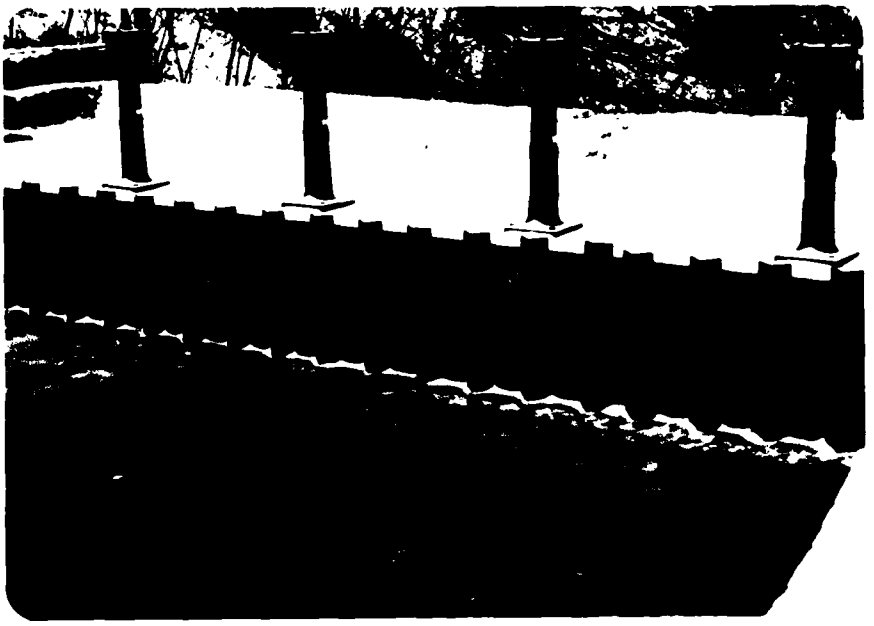


PHOTO NO.3 - Upstream view of gate valves and trash racks at left abutment.

PHOTO NO.4 - Left spillway apron deterioration adjacent to left abutment.

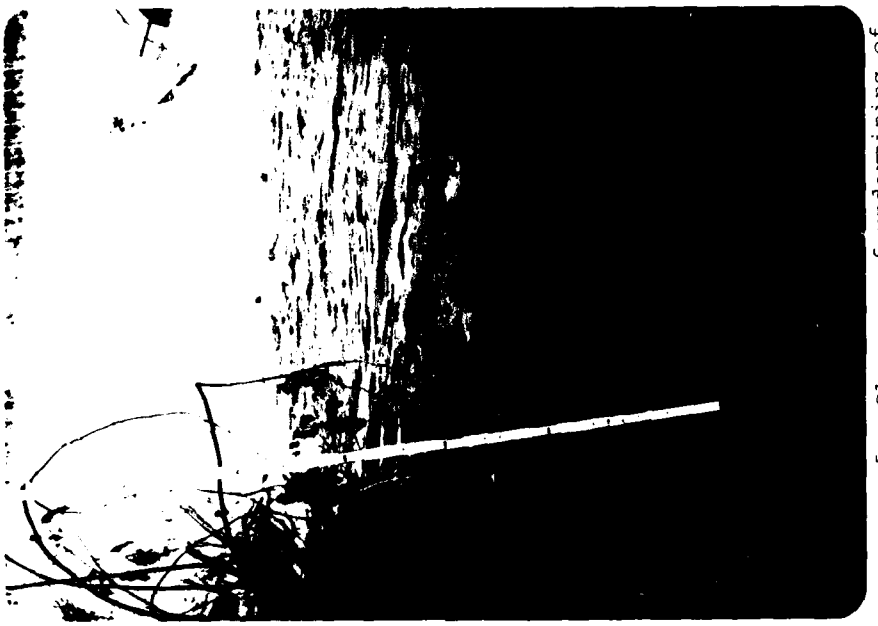


PHOTO NO.5 - Close-up of undermining of left spillway section adjacent to center abutment.

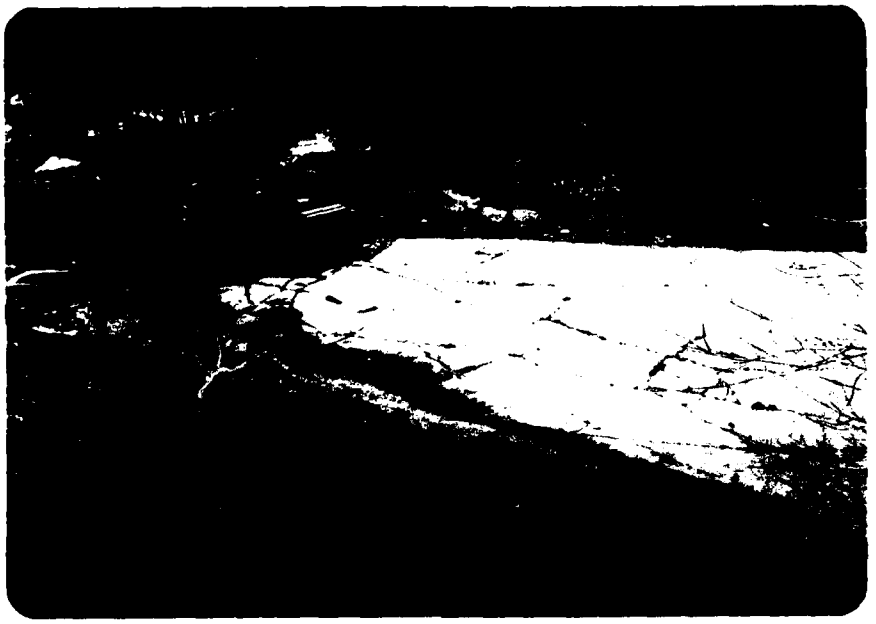


PHOTO NO.6 - Downstream view of right spillway apron deterioration and trees in the downstream channel.

US ARMY ENGINEER DIV. NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MASS.	NATIONAL PROGRAM OF	Hanover Pond Dam Quinnipiac River Meriden, Connecticut
CAHN ENGINEERS INC. WALLINGFORD, CONN. ARCHITECT—— ENGINEER	INSPECTION OF NON-FED. DAMS	CE # 27 595 DATE Feb 1979 PAGE C-3

PHOTO NO.7 - View of dam from left abutment. Note debris and condition of apron at downstream toe of dam.

PHOTO NO.8 - Outlet to four sluices to left of main spillway

APPENDIX

SECTION D: HYDRAULIC/HYDROLOGIC COMPUTATIONS

PRELIMINARY GUIDANCE
FOR ESTIMATING
MAXIMUM PROBABLE DISCHARGES
IN
PHASE I DAM SAFETY
INVESTIGATIONS

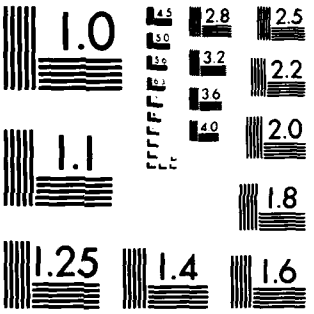
New England Division
Corps of Engineers

March 1978

AD-A144 591 NATIONAL PROGRAM FOR INSPECTION OF NON-FEDERAL DAMS 3/2
HANOVER POND DAM (CT..(U) CORPS OF ENGINEERS WALTHAM MA
NEW ENGLAND DIV FEB 79

UNCLASSIFIED F/G 13/2 NL

END
DATE FILMED
9 84
DTIC

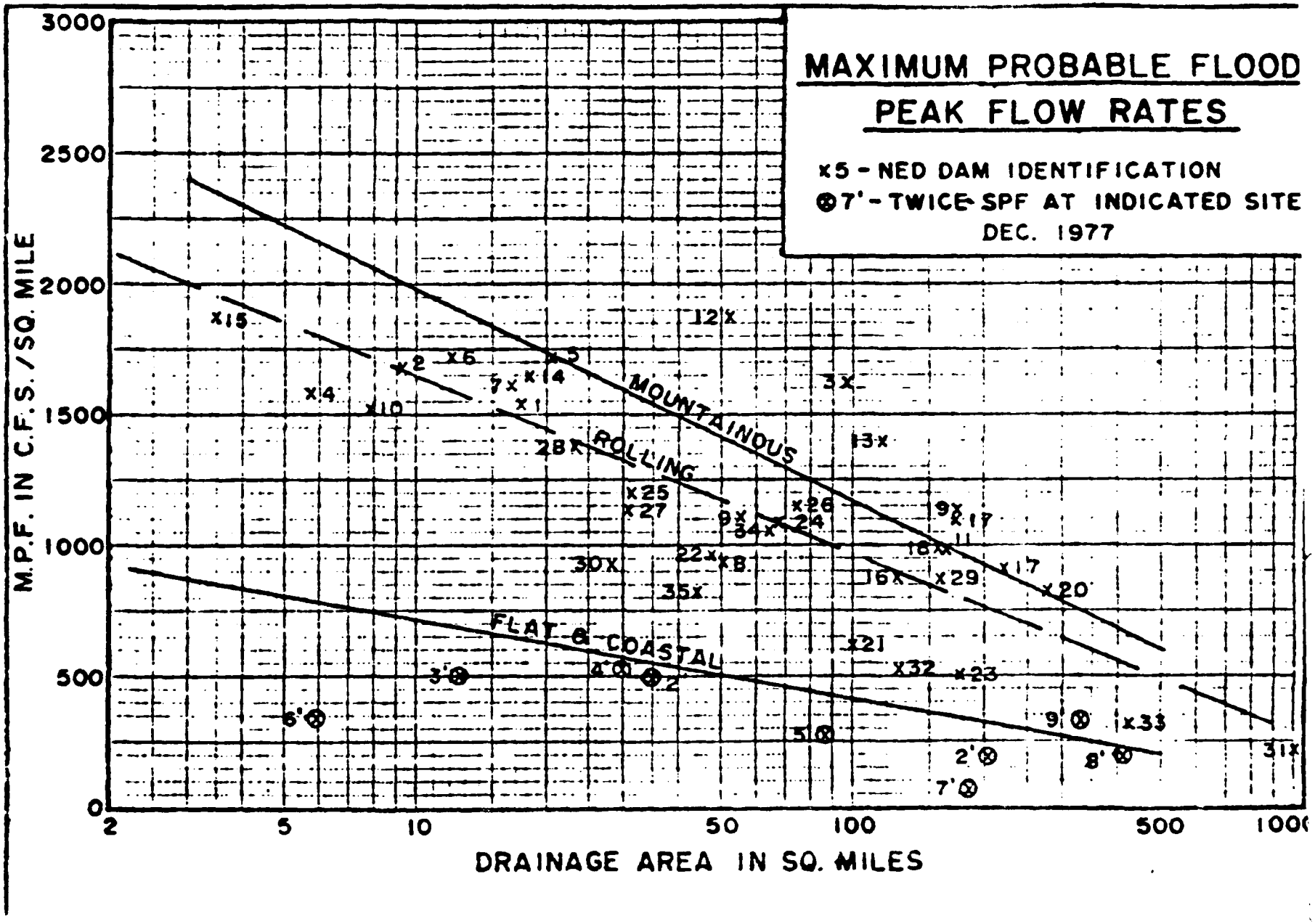


MAXIMUM PROBABLE FLOOD INFLOWS
NED RESERVOIRS

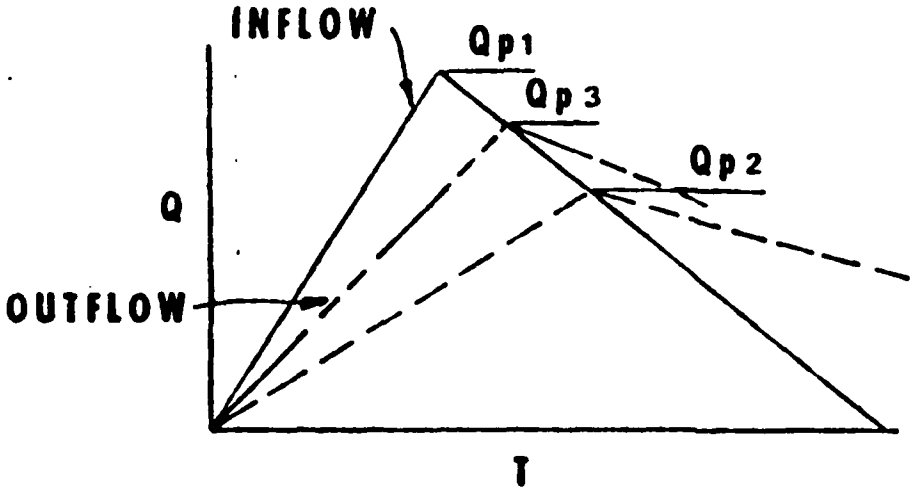
	Project	Q (cfs)	D.A. (sq. mi.)	MPF cfs/sq. mi.
1.	Hall Meadow Brook	26,600	17.2	1,546
2.	East Branch	15,500	9.25	1,675
3.	Thomaston	158,000	97.2	1,625
4.	Northfield Brook	9,000	5.7	1,580
5.	Black Rock	35,000	20.4	1,715
6.	Hancock Brook	20,700	12.0	1,725
7.	Hop Brook	26,400	16.4	1,610
8.	Tully	47,000	50.0	940
9.	Barre Falls	61,000	55.0	1,109
10.	Conant Brook	11,900	7.8	1,525
11.	Knightville	160,000	162.0	987
12.	Littleville	98,000	52.3	1,870
13.	Colebrook River	165,000	118.0	1,400
14.	Mad River	30,000	18.2	1,650
15.	Sucker Brook	6,500	3.43	1,895
16.	Union Village	110,000	126.0	873
17.	North Hartland	199,000	220.0	904
18.	North Springfield	157,000	158.0	994
19.	Ball Mountain	190,000	172.0	1,105
20.	Townshend	228,000	106.0(278 total)	820
21.	Surry Mountain	63,000	100.0	630
22.	Otter Brook	45,000	47.0	957
23.	Birch Hill	88,500	175.0	505
24.	East Brimfield	73,900	67.5	1,095
25.	Westville	38,400	99.5(32 net)	1,200
26.	West Thompson	85,000	173.5(74 net)	1,150
27.	Hodges Village	35,600	31.1	1,145
28.	Buffumville	36,500	26.5	1,377
29.	Mansfield Hollow	125,000	159.0	786
30.	West Hill	26,000	28.0	928
31.	Franklin Falls	210,000	1000.0	210
32.	Blackwater	66,500	128.0	520
33.	Hopkinton	135,000	426.0	316
34.	Everett	68,000	64.0	1,062
35.	MacDowell	36,300	44.0	825

MAXIMUM PROBABLE FLOWS
BASED ON TWICE THE
STANDARD PROJECT FLOOD
(Flat and Coastal Areas)

River	SPF (cfs)	D.A. (sq. mi.)	MPF (cfs/sq. mi.)
1. Pawtuxet River	19,000	200	190
2. Mill River (R.I.)	8,500	34	500
3. Peters River (R.I.)	3,200	13	490
4. Kettle Brook	8,000	30	530
5. Sudbury River.	11,700	86	270
6. Indian Brook (Hopk.)	1,000	5.9	340
7. Charles River.	6,000	184	65
8. Blackstone River.	43,000	416	200
9. Quinebaug River	55,000	331	330


MAXIMUM PROBABLE FLOOD
PEAK FLOW RATES
x5 - NED DAM IDENTIFICATION
⊗7' - TWICE SPF AT INDICATED SITE
DEC. 1977
M.P.F. IN C.F.S./SQ. MILE
DRAINAGE AREA IN SQ. MILES
3000
2500
2000
1500
1000
500
0
2
5
10
50
100
500
MOUNTAINOUS
ROLLING
FLAT & COASTAL
x15
x4
x10
x2
x5
x14
x1
12x
3x
13x
28x
x25
x27
x26
x24
9x
x17
x11
18x
x17
x20
16x
x29
30x
22x
x8
35x
x21
x32
x23
x33
31x
3'⊗
4'⊗
2
6'⊗
5⊗
9'⊗
2'⊗
8'⊗
7'⊗

ESTIMATING EFFECT OF SURCHARGE STORAGE ON MAXIMUM PROBABLE DISCHARGES



STEP 1: Determine Peak Inflow (Qp_1) from Guide Curves.

STEP 2: a. Determine Surcharge Height To Pass "Qp_1".

b. Determine Volume of Surcharge ($STOR_1$) In Inches of Runoff.

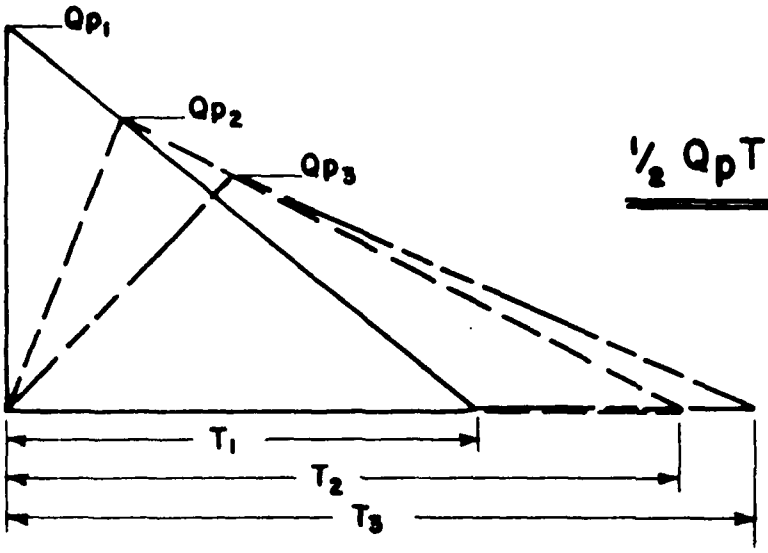
c. Maximum Probable Flood Runoff In New England equals Approx. 19", Therefore

$$Qp_2 = Qp_1 \times \left(1 - \frac{STOR_1}{19}\right)$$

STEP 3: a. Determine Surcharge Height and "$STOR_2$" To Pass "Qp_2"

b. Average "$STOR_1$" and "$STOR_2$" and Determine Average Surcharge and Resulting Peak Outflow "Qp_3".

"RULE OF THUMB" GUIDANCE FOR ESTIMATING DOWNSTREAM DAM FAILURE HYDROGRAPHS



$\frac{1}{2} Q_p T = 12 S$

STEP 1: DETERMINE OR ESTIMATE RESERVOIR STORAGE (S) IN AC-FT AT TIME OF FAILURE.

STEP 2: DETERMINE PEAK FAILURE OUTFLOW (Q_{p1}).

$$Qp_1 = \frac{8}{27} W_b \sqrt{g} Y_o^{\frac{3}{2}}$$

W_b = BREACH WIDTH - SUGGEST VALUE NOT GREATER THAN 40% OF DAM LENGTH ACROSS RIVER AT MID HEIGHT.

Y_o = TOTAL HEIGHT FROM RIVER BED TO POOL LEVEL AT FAILURE.

STEP 3: USING USGS TOPO OR OTHER DATA, DEVELOP REPRESENTATIVE STAGE-DISCHARGE RATING FOR SELECTED DOWNSTREAM RIVER REACH.

STEP 4: ESTIMATE REACH OUTFLOW (Q_{p2}) USING FOLLOWING ITERATION.

A. APPLY Q_{p1} TO STAGE RATING, DETERMINE STAGE AND ACCOPMANYING VOLUME (V_1) IN REACH IN AC-FT. (NOTE: IF V_1 EXCEEDS 1/2 OF S, SELECT SHORTER REACH.)

B. DETERMINE TRIAL Q_{p2}.

$$Qp_2(\text{TRIAL}) = Qp_1 \left(1 - \frac{V_1}{S}\right)$$

C. COMPUTE V_2 USING Q_{p2} (TRIAL).

D. AVERAGE V_1 AND V_2 AND COMPUTE Q_{p2}.

$$Qp_2 = Qp_1 \left(1 - \frac{V_{avg}}{S}\right)$$

STEP 5: FOR SUCCEEDING REACHES REPEAT STEPS 3 AND 4.

APRIL 1978

HYDROLOGIC / HYDRAULIC INSPECTION

HANOVER POND DAM, MERIDEN, CT

I) PERFORMANCE AT TEST FLOOD CONDITIONS:

1) MAXIMUM PROBABLE FLOOD.

a) WATERSHED CLASSIFIED AS "ROLLING" TO "FLAT & COASTAL"

b) WATERSHED AREA DA ≅ 83.0 sq. mi (U.S.G.S. HARTFORD OFFICE. C.M. BLAIR (STATE BOARD OF SUPERVISION OF DAMS) LETTERS / REPORTS TO THE MAYOR OF MERIDEN ON THE HANOVER POND DAM CONDITION - 1938 THROUGH THE EARLY 40's. ACTUALLY, THE TOTAL DRAINAGE AREA IS ± 95.1 sq mi. HOWEVER (±) 12 SQ. MI ARE CONSIDERED TOTALLY OR AT LEAST, MOSTLY DIVERTED TO OTHER WATERSHEDS.)

c) FROM NED-ACE "PRELIMINARY GUIDANCE FOR ESTIMATING MAX. PROBABLE DISCHARGES". GUIDE CURVE FOR PMF - PEAK FLOW RATE.

PMF ≅ 900 CFS/Sq. mi

d) PEAK INFLOW: PMF = 900 × 83 ≅ 74700 CFS

2) SPILLWAY DESIGN FLOOD (SDF):

a) CLASSIFICATION OF DAM ACCORDING TO NED-ACE RECOMMENDED GUIDELINES:

i) SIZE*: STORAGE (MAX.) ≅ 1800 AC. FT. (1000 < S < 50000 AC FT)
HEIGHT ≅ 27' (25 ≤ H ≤ 40 FT)

*SEE NOTES ON NEXT PAGE.

HANOVER POND DAM

2, a - Cont'd) CLASSIFICATION

i - Cont'd) STORAGE: NO DATA ON STORAGE FOR HANOVER POND IS AVAILABLE, EXCEPT ON THE U.S. INVENTORY OF DAMS DATED 12/13/73 WHICH SHOWS 38 AND 53 ACFT FOR FLOWLINE AND MAX. POOL IMPOUNDMENTS. HOWEVER THIS FIGURES COULDNOT BE CORRELATED WITH OTHER DATA ON THE POND AS THE LAKE AREA AT MAX. POOL (A = ± 16 AC. - CONN. DEP) AND DAM/RESERVOIR HEIGHT/ESTIMATED DEPTH, AND SURCHARGE ARE AREA (±160 AC SEE p. 7) BASED ON ROUGH GEOMETRICAL CONSIDERATIONS AND CORRELATION WITH LAKE AREA/HEIGHT - STORAGE RATIOS FOR OTHER RESERVOIRS, THE STORAGE FOR HANOVER POND HAS BEEN ASSUMED. $S_{MAX} \cong$ 1800 AC. FT. HEIGHT: ESTIMATED FROM C.E. FIELD OBSERVATIONS/SURVEY.

ii) HAZARD POTENTIAL: THE DAM IS SURROUNDED BY URBANIZED PORTIONS OF MERIDEN, CT. - LOW HOUSING JUST BELOW THE RIGHT SIDE EMBANKMENT MAY BE FLOODED IF DAM IS OVERTOPPED. ALTHOUGH THIS AREA IS CONSIDERED THE IMMEDIATE IMPACT AREA, THERE ARE FURTHER D/S URBAN AREAS OF YALESVILLE, CT. WHICH HAVE EXPERIENCED SERIOUS FLOODING AS RECENT AS OF JAN. 24, 1979 AND THAT WILL BE IN THE PATH OF A FLOOD WAVE GENERATED BY THE FAILURE OF THE HANOVER POND DAM. FURTHER, BACKWATER FROM THE HANOVER POND ISOLATES AT TIMES LOW HOUSING AREAS U/S SODOM BROOK, FORCING THE OPENING OF THE RESERVOIR GATES.

iii) CLASSIFICATION:

SIZE: INTERMEDIATE
HAZARD: HIGH

b) SDF = PMF = 74700 CFS ½ PMF ≅ 37400 CFS

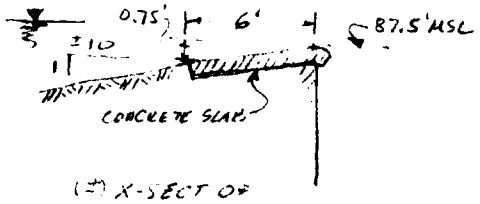
HANOVER POND DAM

3) SURCHARGE AT PEAK INFLOWS:

a) PEAK INFLOW: $Q_{P_1} = 74700$ CFS $\quad Q'_{P_1} = \frac{1}{2} PMF = 37400$ CFS

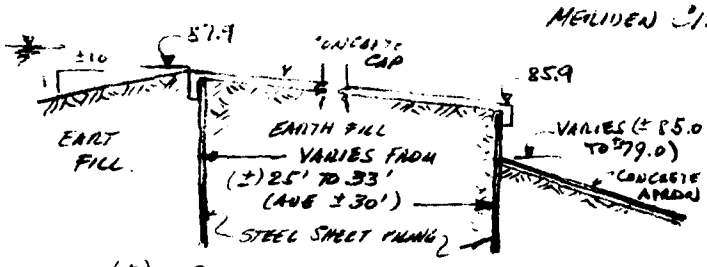
b) SPILLWAY (OUTFLOW) RATING CURVE

1) SPILLWAY:



(±) X-SECT OF ORIGINAL SPILLWAY

THE ORIGINAL SPILLWAY IS CLASSIFIED AS BROAD CRESTED WITH INCLINED U/S FACE ON (±) 8" TO 1'. THE APPROACH TO THE SPILLWAY IS ASSUMED VERY SHALLOW AND AT LEAST FOR MOST OF ITS LENGTH, SLOPING VERY GENTLY, ALMOST AS AN U/S CONTINUATION OF THE SPILLWAY CONCRETE SLAB. (FROM MERIDEN CITY ENG'R OFFICE MAPS & C.E. FIELD SURVEY & OBSERVATIONS). THE NEW SECTION OF THE SPILLWAY IS ALSO CLASSIFIED AS A TRIANGULAR TO BROAD CRESTED SPILLWAY WITH (±) 10" TO 1' U/S SLOPE AND (±) 15" TO 1' AVE. D/S SLOPE. (VERY FLAT SLOPES)



(±) X-SECT OF AUXILIARY (NEW) SPILLWAY

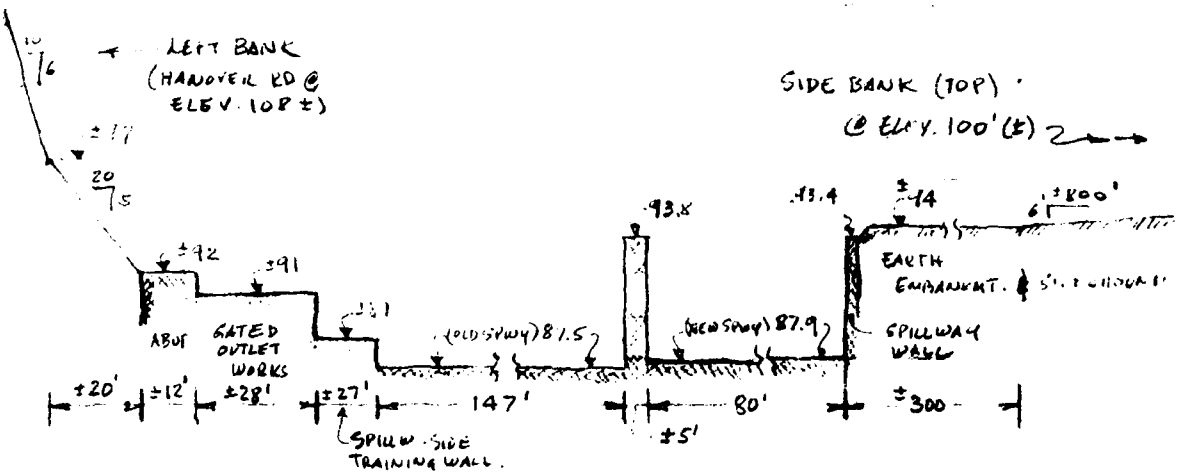
THE CREST OF THE OLD SECTION OF THE SPILLWAY IS (±) 0.4' LOWER THAN THE NEW SPILLWAY CREST. THE TWO SPILLWAYS ARE SEPARATED BY A CENTRAL PIER OF VARIED CROSS-SECTION AND ALIGNMENT (SEE C.E. HANOVER POND DAM DRAWING)

IN PLAN, THE SPILLWAYS ARE ARCHED WITH CREST LENGTHS OF (±) 147' (OLD SPWY) AND 80' (NEW SPILLWAY).
THE MAX. HEIGHT FROM THE LOWER SPILLWAY CREST (EL. 87.5 MSL) TO THE TOP OF THE EARTHFILL (RIGHT SIDE) AT (±) ELEV. 94.0 IS (±) 6.5'!
A GENERAL PROFILE ALONG THE CRESTS OF THE SPILLWAYS / DAM IS

HANOVER POND DAM

3.6 - Cont'd) OUTFLOW RATING CURVE

APPROX AS FOLLOWS (FROM THE CITY OF MERIDEN ENGINEERING DEPT. PLANS & C.E. SURVEY / FIELD OBSERVATIONS):



∴ SPILLWAY DISCHARGE COEFFICIENT, ASSUME C = 3.1 FOR BOTH SPILLWAYS:

USING THE OLD SPILLWAY CREST ELEV. AS DATUM (ELEV. 81.5), THE SPILLWAYS DISCHARGE IS APPROXIMATED BY:

$$Q_S = 460 H^{3/2} + 250 (H - 0.4)^{3/2}$$

(ii) EXTENSION OF RATING CURVE FOR SURCHARGE HEADS ABOVE (±) ELEV. 87 (TOP OF LOWEST PORTION OF DAM):

ASSUME C = 2.7 FOR OVERFLOW AT ALL OTHER PORTIONS OF DAM
C = 2.5 FOR EARTH EMBANKMENT & SIDE BANKS.

ASSUME ALSO, EQUIVALENT LENGTHS FOR THE SLOPING TERRAIN AT THE SIDES OF THE DAM, AS FOLLOWS:

MANOYCK POND DAM

3,6-(Cont'd) OUTFLOW RATING CURVE

$$L_R' = \frac{2}{3}\left(\frac{100}{6}\right)(H-6.5)$$

$$L_L' = \frac{2}{3}\left(\frac{20}{5}\right)(H-4.5) \qquad (H \leq 9.5)$$

$$L_L'' = \frac{2}{3}\left(\frac{10}{6}\right)(H-9.5) \qquad (H > 9.5) \qquad \text{(NEGLIGIBLE)}$$

THEREFORE, THE TOTAL OVERFLOW RATING CURVE CAN BE APPROXIMATED BY:

$$Q_N' = 460\,H^{3/2} + 250\,(H-0.4)^{3/2} + 13\,(H-1.5)^{3/2} + 76\,(H-3.5)^{3/2} + 32\,(H-4.5)^{3/2} + 750\,(H-6.5)^{3/2} + 6.2\,(H-4.5)^{5/2} + 220\,(H-6.5)^{5/2}$$

THE OUTFLOW RATING CURVE IS PLOTTED ON NEXT PAGE

c) SPILLWAY CAPACITY TO TOP OF DAM

i) TO ELEV. 91' (TOP OF CONCR. CIVIL WORKS STRUCTURE): $H = 3.5'$ $Q_{S_1} = 4600^{cfs}$
(6.2% OF Q_{P_1} ; 12% OF Q_{P_1}')

ii) TO ELEV. 93.4' (TOP OF AUX. SPILLWAY RIGHT WALL): $H = 5.9'$ $Q_S = 10300^{cfs}$
(14.5% OF Q_{P_1} ; 29% OF Q_{P_1}') - (NOTE: THIS ASSUMES FLOW OVER THE GATED / OTHER CONCRETE PORTIONS OF THE DAM)

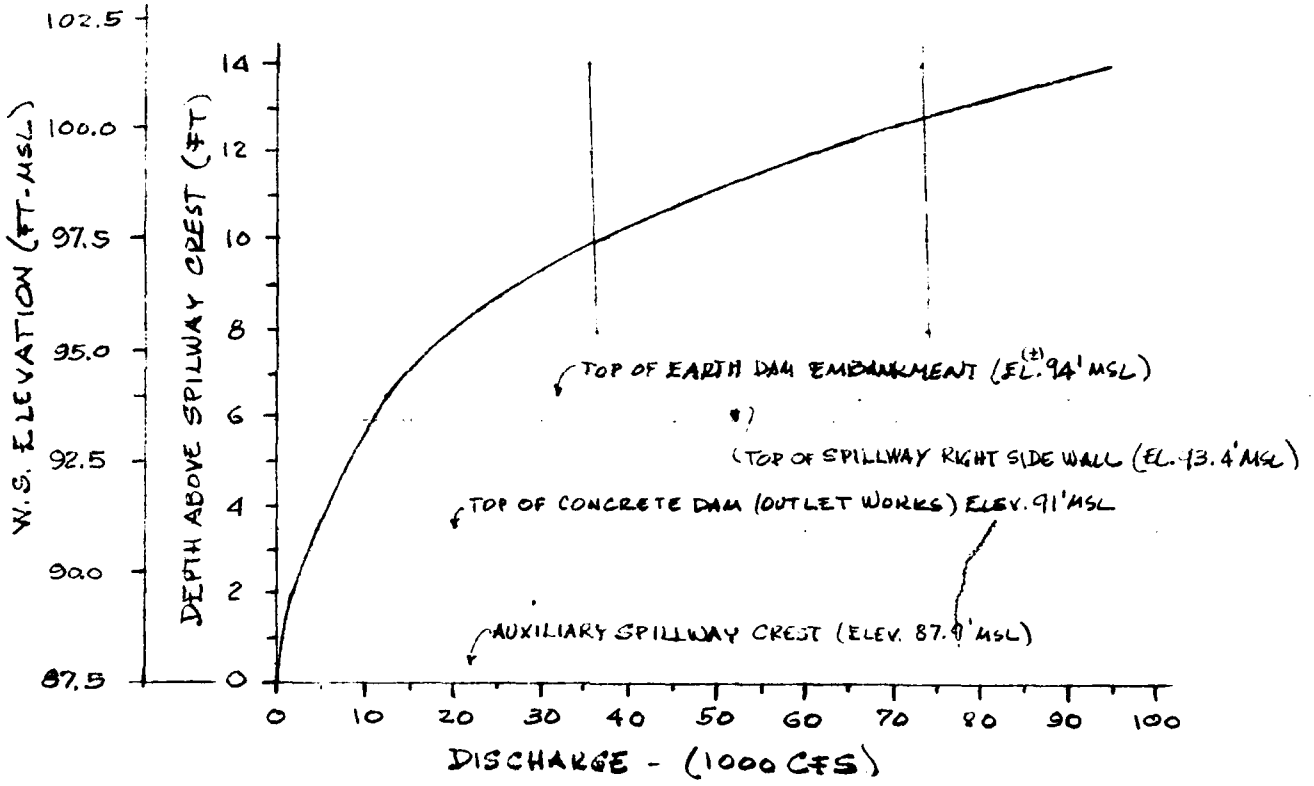
d) SURCHARGE HEIGHT TO PASS Q_{P_1}:

i) @ $Q_{P_1} = PMF = 74,100^{cfs}$ $H_1 = 12.7'$

ii) @ $Q_{P_1}' = \frac{1}{2}PMF = 37400^{cfs}$ $H_1' = 10.1'$

HANOVER POND DAM

3-Cont'd) OUTFLOW RATING CURVE



NOTE: 4-6'x4' BOTTOM GATES W/ASSUMED ℄ ELEV. 70'(±) MAY ADD UNDER CERTAIN CONDITIONS EMERGENCY OUTFLOW CAPACITY. THE GATE OPERATORS ARE DURING MAJOR FLOODING, INACCESSIBLE. BECAUSE OF THIS AND BECAUSE THEIR OPERATIONAL CONDITION AT THE TIME OF AN EMERGENCY MAY NOT BE ASCERTAINED, THE GATES ADDITIONAL CAPACITY HAS NOT BEEN CONSIDERED IN THIS ANALYSIS. FURTHER, THE CAPACITY OF THE GATES AT HIGH TAILWATER PROBABLY WILL NOT AMOUNT TO MORE THAN (±) 2000 CFS AT PMF CONDITIONS, A SMALL PERCENTAGE OF THE TOTAL INFLOW/OUTFLOW.

HANOVER POND DAM

4) EFFECT OF SURCHARGE STORAGE ON MAX PROBABLE DISCHARGES (OUTFLOW)

a) RESERVOIR (POND) AREA @ FLOW LINE: $^{*}A_o = 76^{AC.}$

*FROM CONN. DEP. - WATER & RELATED RESOURCES - INVENTORY SHEET C.E. CHECK MEASURE (U.S.G.S 1:24000): $A \simeq 72^{AC}$; TOL CONTOURS SHOWN ABOVE WATER LEVEL: 1) 3' ABOVE W.L., $A = 127^{AC.}$; 2) 13' ABOVE W.L., $A = 263$ ACR.

∴ ASSUME AVE. LAKE AREA WITHIN EXPECTED SURCHARGE, $A_{AVE} \simeq 160^{AC.}$

b) ASSUME NORMAL POOL LEVEL AT AUXILIARY SPILLWAY CREST (ELEV. 87.4' MSL) i.e., 0.4' ABOVE OLD SPILLWAY CREST.

c) WATERSHED AREA D.A. $\simeq 83^{SQ\ MI}$ (SEE P. 1)

d) DISCHARGE (Q_{P_2}) AT VARIOUS SURCHARGE ELEVATIONS:

$H = 14'$ $V = 160\,(14 - 0.4) = 2170^{AC\text{-}FT}$ ∴ $S = \frac{2170}{83 \times 53.3} = 0.49"$

$H = 12'$ $V = 1860^{AC\text{-}FT}$ ∴ $S = 0.42"$

$H = 8'$ $V = 1020^{AC\text{-}FT}$ ∴ $S = 0.27"$

∴ FROM APPROXIMATE STORAGE ROUTING NED-ACE GUIDELINES (¼ MAX. PROBABLE R.O. IN NEW ENGLAND):

$Q_{P_2} = Q_{P_1}\left(1 - \frac{S}{19}\right)$ AND FOR ½ PMF: $Q'_{P_2} = Q'_{P_1}\left(1 - \frac{S}{9.5}\right)$

HANOVER POND DAM

4, d - "mid" DISCHARGE (Q_{P_2}) AT VARIOUS SURCHARGE ELEVS.

∴ FOR

$H = 14'$ $Q_{P_2} = 72800^{CFS}$ $Q'_{P_2} = 35500$

$H = 12'$ $Q_{P_2} = 73100$ $Q'_{P_2} = 35800$

$H = 8'$ $Q_{P_2} = 73600$ $Q'_{P_2} = 36300$

e) PEAK OUTFLOW (Q_{P_3})

USING NED-ACE GUIDELINES "SURCHARGE-STORAGE ROUTING" ALTERNATE METHOD (SEE p. 6)

$Q_{P_3} \cong 72900^{CFS}$ $H_3 \cong 12.8'$ FOR $Q_{P_1} = PMF$

$Q'_{P_3} \cong 36000^{CFS}$ $H_3 \cong 10.0'$ FOR $Q'_{P_1} = \frac{1}{2}$ PMF

f) SPILLWAY CAPACITY RATIO TO OUTFLOW

i) SPILLWAY CAPACITY TO TOP OF CONCRETE STRUCTURE (GATED OUTLET WORKS) $Q_{S_1} = 4600^{CFS}$

∴ ACTUAL SPILLWAY CAPACITY IS (±)6.3% THE OUTFLOW @ PMF AND (±)13% THE OUTFLOW @ ½ PMF.

ii) ALLOWING ALL CONCRETE PORTIONS OF THE DAM (GATED OUTLET WORKS) TO BE OVERTOPPED SO THE SPILLWAYS MAY SURCHARGE TO THE TOP OF THE AUXILIARY SPILLWAY RIGHT WALL (AGAINST THE EARTH EMBANKMENT) THE CONCRETE DAM/SPILLWAY OVERFLOW CAPACITY IS:

$Q_{S_2} = 10800^{CFS}$ OR ±15% OF THE OUTFL. @ PMF AND 30% OF THE OUTFLOW @ ½ PMF.

HANOVER POND DAM

I-5) PERFORMANCE AT TEST FLOOD CONDITIONS - SUMMARY:

a) PEAK INFLOW Q_{P_1} = PMF = 74700 CFS $Q'_{P_1} = \frac{1}{2}$ PMF = 37400 CFS.

b) PEAK OUTFLOW Q_{P_3} = 72400 CFS Q'_{P_3} = 36000 CFS

c) SPILLWAY MAX. CAPACITY.

i) ACTUAL CAP. (TO TOP OF CONC. DAM STRUCTURE): $Q_{S_1} = 4600$ CFS
(±6.3% OF Q_{P_3} AND ±13 % OF Q'_{P_3})

ii) CAP. ASSUMING CONC. DAM OVERTOPPED TO TOP OF HIGHEST SPLAY TRAINING WALL): Q_{S_2} = 10800 CFS (±15% OF Q_{P_3} AND ±30% OF Q'_{P_3})

THEREFORE, AT SDF = PMF, THE HIGHEST PORTION OF THE DAM (EARTH EMBANKMENT @ ±EL. 94) IS OVERTOPPED (±) 6.3' (W.S. EL ±100' MSL) OR, TO AN AVE. SURCHARGE ABOVE THE SPILLWAY CREST OF (±) 12.8'.

IT IS NOTED THAT SIGNIFICANT HOUSING DEVELOPMENT AROUND HANOVER POND LAYS BELOW ELEV. 100' MSL AND THEREFORE IT WILL BE SERIOUSLY AFFECTED BY BACKWATER OF THE ABOVE ORDER OF MAGNITUDE. AS IT WAS MENTIONED BEFORE, BACK-WATER OF RELATIVELY MORE COMMON OCCURRENCE ISOLATES LOW HOUSING AREAS U/S SODOM BROOK.

HANOVER POND DAM

II) DOWNSTREAM FAILURE HAZARD

1) PEAK FLOOD AND STAGE AT IMMEDIATE IMPACT AREA

NOTE: TWO EMBANKMENT FAILURES AT HANOVER POND ARE KNOWN:
a) AN EMBANKMENT WASHOUT OF (±) 80' WIDTH OCCURRED IN SEPT. 1938 WHEN THE DAM WAS OVERTOPPED. THE APPROXIMATE LOCATION OF THE BREACH IS SHOWN ON THE CITY OF MERIDEN ENGRG. DEPT. DWG. "HANOVER POND DAM - PROFILE ON MASONRY DAM - SECTION 2 EARTH DAM" DATED APRIL 2, 1941. THIS FAILURE OCCURRED PREVIOUSLY TO THE CONSTRUCTION OF THE AUXILIARY SPILLWAY IN 1951.
b) LATER, IN 1968 ANOTHER EMBANKMENT WASHOUT WITH A BREACH OF (±) 75' WHICH REPORTEDLY DRAINED MOST OF THE RESERVOIR, IS RECORDED IN W.P. SANDER, WATER RESOURCES COMMISSION, MEMO TO FILE DATED 4/25/68 (CONN. D.E.P. - WATER & RELATED RESOURCES DEPT. - FILES). IT IS NOT KNOWN WHETHER THE DAM EMBANKMENT WAS OVERTOPPED OR NOT.
THE FIRST FAILURE BROUGHT COURT ACTION BECAUSE OF PARTIAL DESTRUCTION OF A D/S BUILDING. NO MAJOR DAMAGE WAS CAUSED BY THE SECOND FAILURE, AS REPORTED IN SANDER'S MEMO.

COLLAPSE OF THE SPILLWAY APRON BY UNDERMINING IS REPORTED AS A THIRD FAILURE, BY CLARENCE BLAIR & ASSOC. LETTER TO THE DIRECTOR OF THE WATER RESOURCES COMMISSION, W.S. WISE, DATED 11/27/62.

REGARDLESS OF THE RELATIVE MINOR DAMAGES ASSESSED IN PREVIOUS FAILURE EXPERIENCES OF HANOVER DAM, BECAUSE OF THE LOW HOUSING D/S THE DAM AND THE RECENT YALESVILLE FLOOD, THE FOLLOWING IMMEDIATE IMPACT AREA FAILURE FLOOD CONDITIONS ARE ANALYZED:

HANOVER POND DAM

II-1-Cont'd) PEAK FLOOD AND STAGE AT IMMEDIATE IMPACT AREA.

a) BREACH WIDTH:

i) MID-HEIGHT (±) ELEV. 80' MSL ($93.4 - \frac{27}{2} = 79.9$, 80' MSL)

ii) APPROX. MID-HEIGHT LENGTH. $\ell \cong 210'$ (FROM CITY OF MANCHESTER ENG'G DEPT. DWGS & DATA AS COMPILED/ADJUSTED BY C.E.)

iii) BREACH WIDTH (SEE NED-ACE DAM FAILURE GUIDELINES)

$W = 0.4 \times 210 = 84$ ∴ ASSUME $W_b = \underline{80'}$ (CONSISTENT WELL WITH THE EXPERIENCED FAILURES BREACH WIDTHS)

b) PEAK FAILURE OUTFLOW (Q_{P_1})

ASSUME SURCHARGE TO TOP OF DAM (ELEV. 94), THEREFORE,

i) HEIGHT AT TIME OF FAILURE: $Y_o = 27'$

ii) SPILLWAY DISCHARGE: $Q_s = 12800$ CFS

iii) BREACH OUTFLOW (Q_b):

$$Q_b = \frac{8}{27} W_b \sqrt{g}\, Y_o^{3/2} \cong 18900 \text{ CFS}$$

iv) PEAK FAILURE OUTFLOW (Q_{P_1})

$$Q_{P_1} = Q_s + Q_b \cong \underline{31700} \text{ CFS}$$

Cahn Engineers Inc. Consulting Engineers

Project NON FEDERAL DAMS (NEW JERSEY) Sheet 12 of 12
Computed By HW Checked By [illegible] Date 2/1/77
Field Book Ref _____ Other Refs CE #27-595-KA Revisions _____

HANOVER POND DAM

II-1.(cont'd) DOWNSTREAM FAILURE HAZARD

c) FLOOD WAVE HEIGHT IMMEDIATELY D/S OF DAM:

$Y = 3.44 Y_o = 12'$

2) SUMMARY

a) PEAK FAILURE OUTFLOW $Q_{P_1} = 31700$ cfs
b) STAGE AT IMMEDIATE IMPACT AREA $Y = 12'$

D-18

APPENDIX

SECTION E: INVENTORY OF DAMS IN UNITED STATES

INVENTORY OF DAMS IN THE UNITED STATES

(1) STATE	(2) IDENTITY NUMBER	(3) DIVISION	(4) STATE	(5) COUNTY	(6) CONGR DIST.	(7) STATE	(8) COUNTY	(9) CONGR DIST.	NAME	(10) LATITUDE (NORTH)	(11) LONGITUDE (WEST)	(12) REPORT DATE DAY / MO / YR
CT	134	NED	CT	009	05				HANOVER POND DAM	4131.2	7249.6	09FEB79

(13) POPULAR NAME	(14) NAME OF IMPOUNDMENT
	HANOVER POND

(15) REGION	(16) BASIN	(17) RIVER OR STREAM	(18) NEAREST DOWNSTREAM CITY-TOWN-VILLAGE	(19) DIST FROM DAM (MI.)	(20) POPULATION
01	07	QUINNIPIAC RIVER	SOUTH MERIDEN	1	10000

(21) TYPE OF DAM	(22) YEAR COMPLETED	(23) PURPOSES	(24) STRUCTURAL HEIGHT (FT.)	(25) HYDRAULIC HEIGHT (FT.)	(26) IMPOUNDING CAPACITIES MAXIMUM (ACRE-FT.)	(27) IMPOUNDING CAPACITIES NORMAL (ACRE-FT.)
PGHEUT	1950	R	27	25	1600	

DIST	OWN	FED R	PRV/FED	SCS A	VER/DATE
NED	N	N	N	N	09FEB79

(28) REMARKS
20 ESTIMATE 21 MASONRY 22 ORIGINALLY CONSTRUCTED IN 1915 26 ESTIMATE

(29) D/S HAS	(30) SPILLWAY CREST LENGTH	(31) SPILLWAY TYPE	(32) SPILLWAY WIDTH (FT.)	(33) MAXIMUM DISCHARGE (FT.)	(34) VOLUME OF DAM (CY)	(35) POWER CAPACITY INSTALLED (MW)	(36) POWER CAPACITY PROPOSED (MW)	(37) NAVIGATION LOCKS NO	(38) LENGTH (FT.)	(39) WIDTH (FT.)	(40) LENGTH (FT.)	(41) WIDTH (FT.)	(42) LENGTH (FT.)	(43) WIDTH (FT.)	(44) LENGTH (FT.)	(45) WIDTH (FT.)
1	450	U	227	4600												

(46) OWNER	(47) ENGINEERING BY	(48) CONSTRUCTION BY
CITY OF MERIDEN		

(49) REGULATORY AGENCY DESIGN	CONSTRUCTION	OPERATION	MAINTENANCE
NONE	NONE	NONE	NONE

(50) INSPECTION BY	(51) INSPECTION DATE DAY / MO / YR	(52) AUTHORITY FOR INSPECTION
CAHN ENGINEERS INC	07DEC78	PUBLIC LAW 92-367 8AUG1972

(53) REMARKS